Service to which Different Types of Motors are Adapted—
Apparent Dielectric Strength of Varnished Cambric

Electrical World

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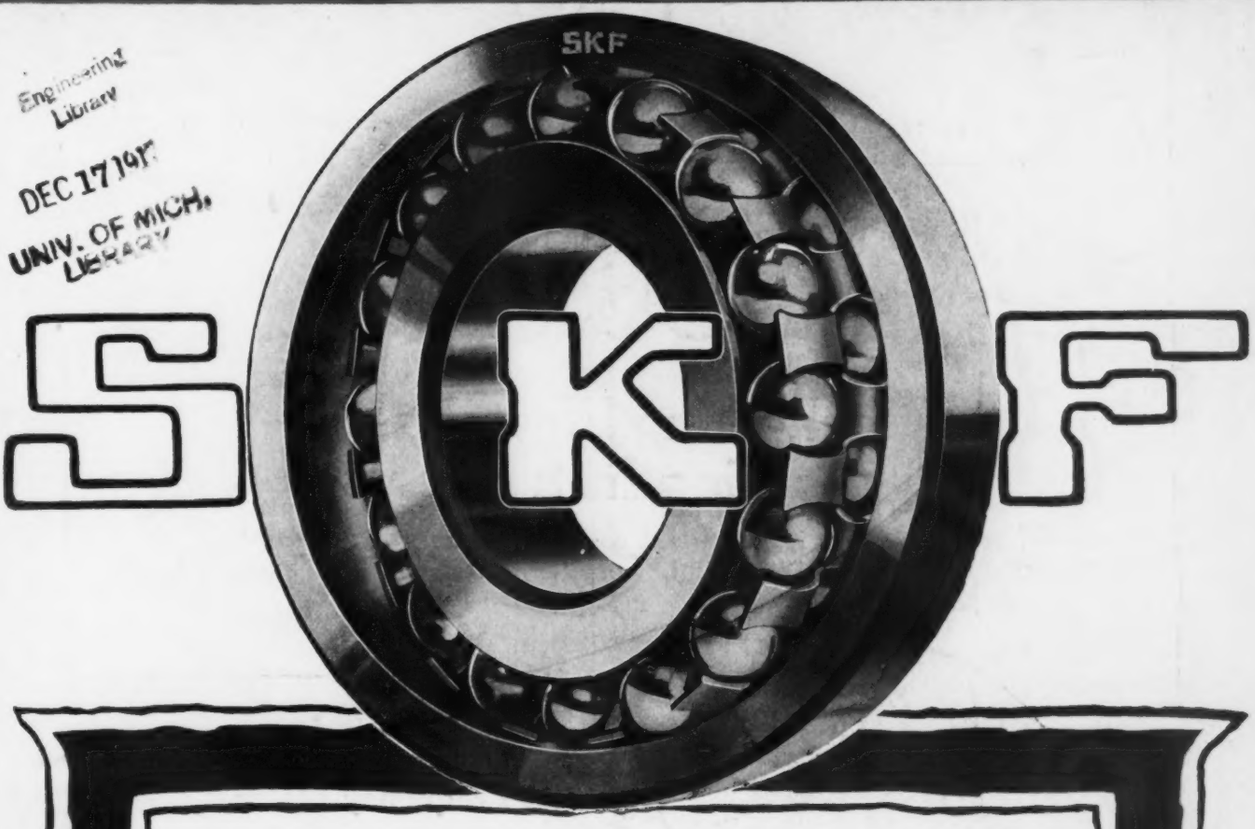

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The Electrically Controlled Torpedo Boat

THERE has been notice of late that the Germans were using off the Belgian coast electrically controlled torpedo boats with which one or more attacks have been made on the British patrols. Enough definite information has now leaked out to authenticate the rumors and to give a rather clear idea as to what the craft actually are. As developed by the Germans the electrically controlled torpedo boat is simply a very fast twin-screw motor launch, well housed in and carrying a very heavy charge of high explosives in the bow. This boat is not manned in any way and is guided from the shore by means of a single-core insulated cable paid out from a drum on the boat, said to carry 30 miles (48.2 km.) or more. Except for the fact that gasoline engines are used for motive power, the scheme is essentially the same as that of the old Sims-Edison torpedo, and even prior devices running back more than thirty years.

The practical difficulty of all such dirigible torpedoes or torpedo boats, whether controlled by a cable or by wireless, is inability to see the course of the boat well enough from the shore to permit effective steering over any considerable distance unless the steering masts are very conspicuous, in which case they are only too obvious to the enemy. Even if equipped, as has been often suggested, with hooded steering lights shining to the rear, the case is not much improved, for the glow from these lights is easily visible to the party attacked and is at best a very uncertain guide in a choppy sea. It is for this reason more than for any other that such dirigible craft have not been to any extent used. In the new German boat, intended to operate over a long radius, steering by shore observation is utterly impracticable, and the direction of the attack lies in a well-guarded hydroplane, which follows up the boat and directs the steering by wireless to the shore station. In this way the observer can keep near enough to the boat and in a sufficiently advantageous position above her to guide her motions with some degree of precision. Thus far the boats have steered a zigzag course either intentionally or accidentally and have not achieved any success whatever. It is one thing to send out a launch on the surface of the water, even well guided from above, and quite another to explode her by contact with a hostile vessel whose rapid-fire guns are going like a pack of firecrackers. The German boat is certainly an ingenious modification of an old idea, but there is little reason to think that the results will have any particular importance. The only really interesting feature of the novelty is the guidance furnished by an aerial observer.

The Engineer as Citizen

DR. IRA N. HOLLIS' presidential address before the American Society of Mechanical Engineers is an inspiring statement of the ideals and duties of citizenship and the relation of the engineer to the state. At the very root of success in democratic government lies the existence of trained administrators, men who are capable of taking up the infinitely varied tasks of governing a nation of 100,000,000 people and of executing them with single-hearted fidelity to country and to conscience. The working out of a democracy to the highest type of government requires for its full development righteousness and intelligence in each and the instinct for team play in all. Unless these qualities are at the front in state and nation, democracy is a hollow sham, a futile imitation of efficient government. Unhappily, highly trained men too often neglect their duties as citizens and keep out of politics, leaving the administration of the nation in the hands of those whose business it is to make politics pay. The engineering professions, however patriotic in spirit, cannot be held entirely blameless in their inclination to retire to the background of political activities. The time has now come, however, when our democracy, grown somewhat careless through long years of peace and smug prosperity, is to be tried in the fire, and unless it is to fail every man who is in any measure inspired by righteousness and intelligence needs without reserve to bend his energies to promoting the common good.

We cannot now do much to repair the failures of the past in providing suitable education for citizenship. We cannot make good the mischief done by the growth of evil precedents in political life, by lax morals in public policies, and by perversion of the rights of the many to add to the gains of the few. This much, however, we can do. From now on we can turn courageously to the task of curing the evils that have sprung up, of setting the nation's house in order for the struggle before it, and of keeping the government unswerving in its purpose to "make the world safe for democracy." Dr. Hollis sets the relation of right-minded men to government under four heads, the routine of business, the organization of research for the benefit of all, the training of men for their country's defense in time of peace, and that grimmer defense duty of training them in time of war. He holds, and very properly, that any ordinary business would be wrecked if as carelessly officered and loosely managed as is the great mechanism of our central government. When a few out of the whole responsible group are found by intellect or by training equal to the demands of their positions we may consider ourselves lucky. Even great

departments, requiring the highest kind of trained skill for their efficient administration, fall into the hands of men well intentioned and patriotic but chosen for political expediency entirely irrespective of their personal abilities. That some of them succeed measurably well despite their lack of qualifications speaks highly for their native ability and is a thing for which to be profoundly thankful. In the legislative branch, as Dr. Hollis notes, the situation is even worse, since for the most part both houses of Congress operate on the lines of petty politics and it is only in some great crisis like the present that they rise out of the mire of small interests and act with larger things in view. There is no such intelligent organization in government as would be found in the conduct of any great business. Improvement in this respect may perhaps be one of the incidental blessings brought on by the curses of war.

The organized research of the government up to the outbreak of hostilities was efficient to the best of its ability and appropriations but smothering in the general atmosphere of apathy toward the higher interests of the nation as a whole. One of the most marked results of the present situation is that at last an emergency organization has been brought together which has done and is doing great things for the national defense. What has been accomplished in the last few months gives some notion of the possibilities of efficiency when the intellectual and executive forces of the people are really mustered into service. As intelligence and righteousness are necessary in the business and technical administration of government affairs, so is that principle of team work which sets the result above the individual, and the highest conception of team work on a vast and vital scale is the organization of the nation's defense by military training. That which can be done in the ordinary routine of the government's business is only what is done every day in any great engineering work. That which must be accomplished for the country's salvation is the team work of armed men, the most perfect example of cooperation that humankind has discovered. In peace, as Dr. Hollis shows, we have been lax to the verge of criminality. The old high principle of the founders of the Republic by which every citizen of military age was to be armed and ready fell into neglect while yet the memory of the War of Independence was fresh. It had passed into a mockery in the days of our grandfathers. The terrible lesson of the Civil War was soon forgotten; that of the Spanish War was never properly learned and was fading from memory, when the world struggle came upon us like a bolt from the blue.

The hope of the nation now is in the fierce and intense efforts at military training to-day to make up for its lack in the yesterdays. The million men who were to spring to arms had neither arms nor leaders for lack of preparation in time of peace. The great question which is coming in the future is how such preparation may be initiated and continued, to the end that we may not again be found unready. That the temper of the people calls for general military training the swift passage of the draft bill through Congress and the ease with which it has been put into effect make clear. The engineering profession, more than any other perhaps, realizes the importance of intelligent team work, and every effort made toward its promotion on a gigantic scale will find the engineers of the country ready to help anywhere from the munition factory to the firing line. Now, when the training neglected in peace has to be applied, the profession must push with the utmost activity along every line that can bring help. Its effect has already been felt on the battle front, on the sea, in the training camp, in the workshop, and the engineer's hand must never slacken in the good work. He must bring all his energies and all his influence to help the nation make up for lost time and to drive home to it the realization that we are in the greatest war of all the ages, wherein all the technical skill of man has been brought to man's destruction and must be fought in kind. This lesson the people at large have not yet learned, and it is the duty of those whose trained intelligence grasps the situation to drive the terrible facts home, to the end that disaster shall not come upon our common country.

The Design of Feeders

IT IS a perfectly simple matter to lay out a feeding system with respect to the fundamental requirements of proper regulation and suitable current-carrying capacity. To meet these demands and at the same time fulfill the requirement of maximum economy is quite a different matter. P. O. Reyneau's paper in the current issue gives some very practical information as to the working methods to be followed in the solution of this problem. It is obvious at the start that in working out feeders for maximum economy the two basic factors, cost of energy and price of copper, are the most troublesome items of the calculation. Indeed, these, particularly the latter, are intrinsically variables, having determinate values only at some particular epoch, so that in laying out a system the best that can be done is to take account of these costs with as much foresight as conditions permit. Mr. Reyneau's efforts are devoted to an approximate solution of the general problem, taking these difficult factors as independent variables. The base of his line of attack is to reduce from tabulated data the year's output over the required feeders to an equivalent current in terms of the yearly peak, producing the same energy loss as the currents in their actual time distribution.

By tabulating the observed data from typical lighting circuits it is possible to arrive at average results which fairly represent the existing state of things, and from this the equivalent daily period with respect to the peak load of the year. This done, a simple graphical representation taking account of variations in cost of energy and of copper enables one to obtain a fairly approximate solution of the economy problem. It is interesting to note how well in agreement are the results experimentally obtained from a dozen different lighting circuits. How closely these will be checked by

experience in other cities is a little uncertain, but the indications are that the approximation will be better than at first sight seems probable. At all events, the different results throw light not only on the general situation, but also on the probable effects of increased load, so that one may intelligently forecast something of what is likely to turn up at a later date not too remote. The one limitation that seems apparent in the method is that the circuits are assumed to be homogeneous; that is, carrying as feeders the same current throughout. It is plain that the element of load wandering will introduce another feature into the calculation, but if this in turn is reasonably subject to general average, one can still take account of it. Data on load wandering are very scarce, yet few subjects are of greater interest in the design of a distribution system, with respect both to the requirements of regulation and economy in the distribution of the conductors. Mr. Reyneau's data will be of very material service in their present form, and we hope to see them extended to cover the somewhat more complicated cases which frequently arise in the course of practice.

Dielectric Strength of Varnished Cambric

WHEN a condenser is formed by two parallel opposed conducting surfaces, such as a pair of flat brass disks separated by a film of air, the electric field between them, when the disks are electrically displaced in potential, is theoretically strongest at the center and diminishes radially outward toward the edges. If, however, the air gap or air-film thickness is less than 5 per cent of the disk diameter, and also if the edges of the disks are slightly rounded, the electric field becomes substantially uniform at all points between the disks. Experiment shows that with the disk faces set fairly parallel to each other in air the disruptive discharges of successive electric breakdowns are then distributed substantially according to the ordinary laws of accidental errors, the pattern formed by the marks on the disk surfaces of the successive spark discharges showing no tendency to crowd at any point.

If, then, a uniform electric field is produced, its intensity should be directly proportional to the impressed voltage between the disks and inversely proportional to the air gap, while the area of the disk electrodes should have no appreciable effect on the dielectric strength of the air film, so long as the thickness of the film is less than 5 per cent of the disk diameter. In other words, the dielectric breakdown voltage of an air film of given thickness, say 0.3 mm., should be the same whether the disk diameters are 2 cm. or 5 cm. The same proposition of dielectric strength independent of the area should likewise apply to flat films of other dielectrics such as oil and varnished cambric.

It was pointed out, however, in a paper by F. M. Farmer, read before the A. I. E. E. in 1913, that the apparent dielectric strength of flat films of air, oil and varnished cambric differed very appreciably with the diameter of the disk electrodes used in the test. The larger the disk the lower the breakdown voltage. There was some difference of opinion expressed, in the discussion following the paper, as to the origin of these variations in apparent dielectric strength; but it was supposed that, at least in the case of varnished cambric, which is necessarily composite in structure and liable to vary somewhat in thickness, the experimental facts might be explained on the basis of accidental weaker spots in the dielectric, so that a large area of electrode would probably cover and include more weak spots and so permit of a lower breakdown voltage.

We are printing this week an interesting article by A. E. Kennelly and R. J. Wiseman on this subject. Their experimental results indicate that in varnished cambric the breakdown voltage diminishes with the diameter in substantially the same manner as Mr. Farmer's original paper showed, but that the diminution in breakdown voltage does not depend upon the area of the electrodes. It appears that the area can be increased over a considerable range without any material diminution in apparent breakdown voltage, provided that the area is electrically broken up into elements separated by wires. This very remarkable experimental result has been checked through tests by other observers, and with other instruments, at the Electrical Testing Laboratories of New York.

The reasons for this experimental result have not yet been cleared up. It is suggested that under the application of an alternating emf. free electric oscillations in the condenser may perhaps be set up from one part to another. If so, the oscillations must have extremely high frequency, with a wave length perhaps measured in decimeters. High-frequency currents are indeed known to possess highly destructive powers on insulating materials, especially in the presence of ionizable gas. However, direct experimental evidence of the presence of such oscillations will be required before we can safely accept this explanation. There is a fine opportunity here for the work of experimental physicists—one of which we hope to see them take advantage.

The Coming Issues

INDUSTRIAL plants and other users of 220-volt incandescent lamps should be interested in an article entitled "Adapting 220-Volt Circuits to 110-Volt Lamps" which will be presented next week, as it will point out how uneconomical it is to use the higher voltage lamps when 110-volt lamps could be adapted to the circuits and used at considerably less expense. Data will be given on the relative prices of the lamps as well as on the luminous output. Steps which were taken by a large textile mill to provide power for increased production will also be outlined. The eighth installment of Prof. C. E. Clewell's series of articles on industrial motor and control applications will also be included in the Dec. 22 issue, the discussion dealing with the fundamental problems of control for industrial-plant motors.

Apparent Dielectric Strength of Varnished Cambric

Its Diminution with Increase of Electrode Diameter Associated with Metallic Structure of Electrode and Possibly Due to High-Frequency Oscillations—Necessity of Standardizing Size of Test Electrodes

BY A. E. KENNELLY AND R. J. WISEMAN

USING varnished cambric 0.3 mm. (0.012 in.) thick between flat metallic-disk electrodes, F. M. Farmer[1] has found that the apparent dielectric strength, in volts per unit thickness, diminishes more than 50 per cent in changing from disks of very small diameter to disks of 15 in. (38 cm.) diameter. In other words, increasing the area of the applied disk electrodes without altering the thickness of the insulating material diminishes greatly the apparent dielectric strength. The same phenomenon was also shown to be present, in varying degrees, with insulating films of hard rubber, oil and air.

In the discussion of Mr. Farmer's paper on this subject the consensus of opinion was in favor of attributing the apparent relative weakness of large plates to the probability of weak spots in the cambric. That is, admitting that a cambric sheet cannot have exactly the same dielectric strength at all points, if only on account of accidental variations in thickness, it must follow that a large-disk electrode is more likely to cover a weak spot than a small electrode and thus will break down the dielectric at a lower impressed voltage.

Although the above weak-spot argument cannot be denied, it is difficult to say how much of the observed falling off in the dielectric strength of large sheets is attributable to it. If all of the diminution with increase in electrode size were due to weak spots, then similar tests of oil films or air films should reveal no such diminution, because weak spots can hardly occur in homogeneous fluid media. However, Mr. Farmer's paper showed marked diminutions toward large diameters both with oil and air films.

The problem of diminution in the apparent dielectric strength of cambric between flat-disk electrodes of increasing size was also studied at the Massachusetts Institute of Technology in 1913-14 by L. H. Webber, who repeated a number of Mr. Farmer's observations and confirmed them in essential particulars.

INFLUENCE OF OIL IMMERSION ON CAMBRIC

The subject was further investigated at the Massachusetts Institute of Technology in 1914-15 by G. Y. Fong, who again confirmed Mr. Farmer's observations on varnished cambric. It was further found that when the cambric was first immersed in transformer oil and then placed between opposed parallel disk electrodes the falling off in dielectric strength between 1.3-cm. (½-in.) and 10-cm. (4-in.) electrodes was distinctly less than when the cambric was immersed in atmospheric air. When the tests were made on linseed-oil-soaked cambric the apparent dielectric strength was substantially uniform for all sizes of disk electrodes between 1.3 cm. and 25 cm. (½ in. and 9.8 in.). When the tests were made on castor-oil-soaked cambric the apparent dielectric strength actually increased slightly when the disk diameter was increased.

Later it was found that the results with linseed oil, and especially with castor-oil-soaked cambric, were not reliable, owing to the viscosity of these oils. That is, when specimens were tested between large disks it was very difficult to squeeze out the excess oil, and the thickness of the test substance was actually increased by the layers of unexpelled oil. All that can be claimed, therefore, is that when air is replaced by oil as the medium immersing the cambric there is less falling off in apparent dielectric strength where larger sizes of electrodes are used.

INVESTIGATIONS OF DIELECTRIC STRENGTH WITH MULTIPLE ELECTRODES

More extensive investigation of the whole subject was permitted in the research division of the M. I. T. electrical engineering department in July, 1915, by an appropriation from the American Telephone & Telegraph Company, the experimental work being conducted by Dr. R. J. Wiseman.

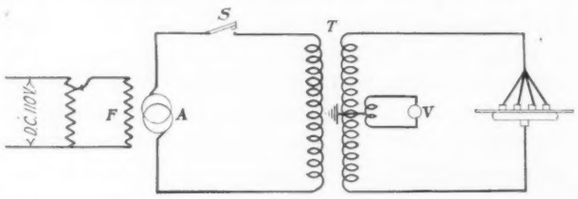


FIG. 1—CONNECTIONS USED IN TESTING DIELECTRIC STRENGTH OF VARNISHED CAMBRIC

A is a motor-driven 220-volt, 20-kva. alternator, operated at constant speed and frequency (60 cycles) by a direct-connected motor not shown. The voltage at the armature terminals is controlled by a drop-wire rheostat connected to 110-volt direct-current mains on one side and to the alternator field magnets on the other. In all of the tests the drop-wire rheostat was so operated as to raise the voltage at the rate of approximately 1000 r.m.s. volts per second. The high-tension transformer *T* has a rating of 10 kva. at 50,000 r.m.s. volts on the secondary. A tertiary coil in the transformer is connected to a voltmeter calibrated to show the voltage at secondary terminals. The centers of both secondary and tertiary coils are grounded. Short leads extend from the secondary terminals to the horizontal electrodes on the test specimen. The voltmeter *V* is fairly dead-beat in its indications and is read at the instant of first discharge, which is revealed not only by the sound of the rupture spark but also by the sudden falling of the voltage. A foot switch *S*, in the primary circuit, is then immediately opened so as to extinguish the arc.

After checking the results obtained by Mr. Farmer with cambric, tests were made with a number of small-disk electrodes of equal size, electrically connected into a "multiple electrode," as is indicated in Fig. 3. The lower electrode consisted of a single metallic disk, as before, and this supported the cambric test sheet. On the test sheet rested the multiple electrode of small metallic disks, all connected by flexible fine copper wires about 40 cm. (15.7 in.) long. Each individual small disk had a length of 1.2 cm. (0.47 in.) and a diameter of 1.2 cm. (0.47 in.), and its edge was slightly rounded. The number of these little disks forming the multiple electrode was varied in different tests from

[1] "The Dielectric Strength of Thin Insulating Materials," *Transactions A. I. E. E.*, Vol. 32, p. 2097, December, 1913.

one up to sixteen, corresponding in total active area to that of a single-disk electrode from 1.2 cm. up to 4.8 cm. (0.47 in. to 1.9 in.) in diameter.

The connections used in the tests are shown in Fig. 1. Then observations, made in rapid succession and occupying about ten minutes, constitute a test. After

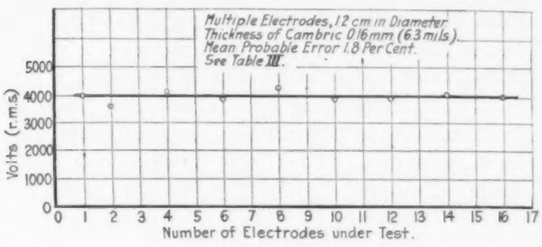

Multiple Electrodes, 12 cm in Diameter
Thickness of Cambric 0.16 mm (6.3 mils)
Mean Probable Error 1.8 Per Cent.
See Table III.
Volts (r.m.s.)
5000
4000
3000
2000
1000
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
Number of Electrodes under Test.

FIG. 2—CHANGE IN PUNCTURING VOLTAGE OF VARNISHED CAMBRIC, WITH NUMBER OF ELECTRODES USED IN MULTIPLE

the series is completed the thickness of each sample is measured by a micrometer close to the point of rupture. The arithmetical mean of the ten thicknesses so measured is taken as the mean thickness of the cambric. The arithmetical mean of the ten breakdown voltages, after each has been corrected for the thickness of the corresponding test piece, is taken as the mean breakdown voltage for the mean thickness of the series. The probable error of both the mean voltage and the mean thickness is recorded[1] with the test. It is customary to find the probable error of mean voltage to be about 1.5 per cent, and the probable error of mean thickness to be about 1 per cent.

In order to maintain a substantially uniform electric field between opposite disk electrodes it was found that it was necessary to have the gap not exceed 5 per cent of the electrode diameter. This ratio was determined experimentally with films of air by observing the marks left by the discharges on the electrode disks. The

TABLE I—TEN OBSERVATIONS OF THE PUNCTURING VOLTAGE OF VARNISHED CAMBRIC BETWEEN A PARTICULAR SET OF METALLIC ELECTRODES*

No.	Observed R.M.S. Puncturing Emf. (Volts)	Thickness of Sample (Mm.)	Voltage Corrected to Mean Thickness
1	6110	0.155	6360
2	5860	0.162	5840
3	5990	0.163	5920
4	6360	0.155	6610
5	5990	0.161	5990
6	6110	0.164	6030
7	5740	0.169	5450
8	6240	0.162	6210
9	6360	0.153	6720
10	6360	0.169	6050
		Mean 0.1613 (1 ±0.0075)	6118 (1 ±0.013)

*Conditions of test: Lower electrode, a solid steel disk 10.2 cm. in diameter; upper electrode, thirteen small brass cylinders each 1.1 cm. in diameter and 1.1 cm. long, held in same manner by a perforated hard-rubber base. Medium surrounding the cambric, air. Temperature, 26 deg. C. Frequency, 60 cycles

marks began to concentrate perceptibly toward the centers of the disks when the gap exceeded 5 per cent of the diameter. Consequently, in order to eliminate effects due to non-uniformity of electric field, all of the observations here presented are limited to electrode diameters which are more than twenty times the thickness of cambric. In fact, diameters of less than 1 cm. (0.39 in.) have not been used. Limiting the minimum diameter to 1 cm. (0.39 in.) has the further advantage of obtaining a more representative sample of the test sheet. Mr. Farmer, as pointed out in his 1913 paper, carried the minimum electrode diameter to much lower

TABLE II—COMPARATIVE MEAN PUNCTURING VOLTAGES WITH SINGLE DISK ELECTRODES

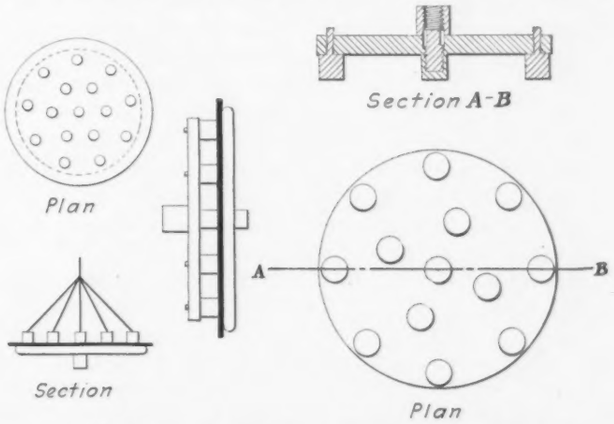
(Diameters between 1.2 cm. and 25.4 cm.; varnished cambric 0.16 mm. thick; surrounding medium, air; ten observations to each series)

Diameter (In.)	Diameter (Cm.)	Surface Area (Sq. Cm.)	Mean R.M.S. Puncturing Voltage (V)	Apparent Dielectric Strength Volts per Mm. V/S
0.47	1.2	1.13	7,350 (1 ±0.016)	45,900
2.0	5.1	20.4	6,570 (1 ±0.0074)	41,100
4.0	10.2	81.6	5,620 (1 ±0.0079)	35,100
6.0	15.2	181.4	5,350 (1 ±0.020)	33,400
8.0	20.3	324.0	5,500 (1 ±0.015)	34,400
10.0	25.4	506.0	5,090 (1 ±0.027)	31,800

values, and even to needle points, for the purpose of more comprehensive comparison. Reducing the limits of diameters in Mr. Farmer's paper to, say, 1.1 cm. and 5.1 cm. (0.47 in. and 2 in.), to permit comparison with results reported here, it appears that the diminution in apparent dielectric strength reported by Mr. Farmer was from 1120 volts per mil to 970 volts per mil, or 13.4 per cent, which agrees very closely with recent results.

RESULTS WITH MULTIPLE ELECTRODES

When multiple electrodes, like the one shown in Fig. 3, replaced solid single-disk electrodes the diminution of apparent dielectric strength with increasing area largely disappeared. That is to say, if the increase in area of the electrodes was from 1.13 sq. cm. to 18.1 sq. cm. (0.175 sq. in. to 2.81 sq. in.), by changing the diameter from 1.2 cm. to 4.8 cm. (0.47 in. to 1.8 in.) the puncturing voltage fell off more than 13 per cent; whereas when the same increase in area was effected



FIGS. 3, 4 AND 5—SECTIONS THROUGH TWO TYPES OF MULTIPLE-DISK ELECTRODES USED IN TESTS

by multiple electrodes (sixteen electrodes each of 1.13 sq. cm.) the puncturing voltage fell off only about 1 per cent. This remarkable result was independently checked both at the M. I. T. laboratory in Cambridge and at the Electrical Testing Laboratories of New York. This result was checked in various ways, and it

[1] See Tables II and III.

controverts the weak-spot theory of the diminution, because there should be as great a probability of encountering a weak spot under 18 sq. cm. (2.79 sq. in.) of a solid disk as under 18 sq. cm. of a multiple electrode.

The results obtained with a multiple electrode of varying number of disks are shown in Fig. 2, each

TABLE III—COMPARATIVE MEAN PUNCTURING VOLTAGES*

(Lower disk electrode, 25.4 cm. in diameter, and upper electrode, consisting of a selected number of 1.2-cm. disk electrodes in multiple,† for varnished cambric 0.16 mm. thick; surrounding medium, air; ten observations to each series)

Number of Electrodes	Equivalent Diameter of Single Electrode Cm.	Total Surface Area of Multiple Electrode Sq. Cm.	Mean R.M.S. Puncturing Voltage (V)	Apparent Dielectric Strength, Volts per Mm. V/S
1	1.2	1.13	3,920 (1 ± 0.015)	24,500
2	1.7	2.26	3,580 (1 ± 0.033)	22,400
4	2.4	4.52	4,100 (1 ± 0.025)	25,600
6	2.94	6.78	3,810 (1 ± 0.018)	23,800
8	3.39	9.04	4,130 (1 ± 0.010)	25,800
10	3.8	11.3	3,810 (1 ± 0.021)	23,800
12	4.15	13.56	3,860 (1 ± 0.0089)	24,100
14	4.48	15.82	3,920 (1 ± 0.0086)	24,500
16	4.8	18.08	3,890 (1 ± 0.020)	24,300

*See Fig. 2. †See Fig. 3.

circle representing the arithmetical mean value of a series of ten observations of puncture on different samples of the same cambric sheet. Similar results were obtained with multiple electrodes on both sides of the test sheet.

The reasons for the above remarkable disparity between the results with single and multiple electrodes baffled investigation for a long time. A hint toward the solution was found, however, when tests were made with a multiple electrode of thirteen disks, each 1.2 cm. in diameter and 1.2 cm. long (0.47 in. by 0.47 in.) clamped in a perforated brass frame, 10 cm. (3.9 in.) in diameter, so as to form virtual projections from its surface. A section of this electrode, through the axis, is given in Fig. 4. The diminution in puncturing voltage in passing from one disk to sixteen with this multiple electrode was found to be greater than for the single disk of equivalent active surface. This showed that the diminution in apparent dielectric strength with increasing area was associated in some way with the metallic structure of the electrode. The same increase in surface with separated small disks gave very little diminution, whereas when obtained either in a solid disk or in a metallically framed set of small disks the diminution was large. Special series of tests showed that the weight or mechanical pressure on the upper electrode did not appreciably affect the results.

A hard-rubber base or connecting frame was then substituted for the brass base, as shown in section by Fig. 5. The small-disk electrodes were screwed into the rubber base and then ground to a flat testing surface. The disks were connected electrically to a common main terminal by a corresponding number of fine enameled copper wires of 0.25 mm. (0.00985 in.) diameter, each 40 cm. (15.7 in.) long. The tests with this electrode showed a diminution of 5.8 per cent in apparent puncture voltage between one and sixteen electrodes (1.13 sq. cm. to 18.1 sq. cm.).

When the tests were repeated with the disks directly connected by very short copper wires of the same diameter the diminution mounted to 10.8 per cent. In other words, changing the length of the fine connecting wires between the elements of the multiple electrode from 40 + 40 cm. to 2 cm. changed the diminution from 5.8 to 10.8 per cent. These results, which are presented in the first column of Table IV, were communicated to the Electrical Testing Laboratories, where Mr. Farmer repeated the tests, using the same electrodes. The varnished cambric used for the check tests was, however, not just the same as that which had been employed originally. The results of the check tests are given in columns 2, 3 and 4 of Table IV, and their arithmetical means in the last column. Each entry represents the mean of twenty observations at successive breakdowns made in the same way.

It will be seen that although the numerical values of the percentage reductions of breakdown voltage for the different conditions enumerated are by no means the same, yet there is a general qualitative agreement and check between the results in the two laboratories. Furthermore, there is no difference of opinion as to the main facts, namely, that when the electrode forms an electrically solid mass the dielectric-strength diminution is large, while, on the contrary, as the elements of the multiple electrode are separated electrically, without altering the total active surface, the diminution tends to disappear.

The results suggest that the diminution in apparent dielectric strength may possibly be due to high-frequency electric oscillations set up across the dielectric, with the electrodes forming a pair of parallel oscillators. When the diameter of the disk electrodes is increased the oscillating system becomes enlarged, so that its free oscillations would be lowered in frequency but would be increased in amplitude. Under the influence of such oscillations the air pocketed between

TABLE IV—COMPARATIVE DIMINUTION IN MEAN PUNCTURING VOLTAGE FOR VARNISHED CAMBRIC

(Upper electrode areas from 1.1 sq. cm. to 18 sq. cm. in different arrangements; surrounding medium, air)

	M.I.T.	Electrical Testing Laboratories			Mean
Thickness of cambric, mm	0.16	0.15	0.15	0.3	....
Thickness of cambric, mils	6.3	6	6	12	....
Mean breakdown voltage, approximate kv.	7	3	3	13	....
Types of Upper Electrode	Percentage Diminution				
1. Solid disk	13.3	12.2	21.5	10.7	14.8
2. Multiple electrodes held in metallic base	15.4	4.7	20.0	9.4	11.3
3. Multiple electrodes held in hard-rubber base with short connecting wires	10.8	14.2	2.5	8.7	8.5
4. Multiple electrodes held in hard-rubber base with thin connecting wires 40 cm. long	5.8	3.1	7.7	5.4	5.4
5. Separated multiple electrodes with long, thin connecting wires and without a connecting frame	1.0	....	....	....	....

the electrodes and the surfaces of the cambric sheet may be ionized and forcibly impelled against the dielectric in such a manner as to weaken it rapidly. Moreover, the larger the area of the single-disk electrodes the more likely are these air pockets to present themselves, owing to slight irregularities in the thickness of the cambric. When multiple electrodes are used,

with the elements spread out and interconnected by long fine wires, less opportunity is offered for the formation of air pockets and for the high-frequency oscillations to develop an appreciable intensity. The disruptive power of high-frequency oscillations in dielectrics, under the influence of ionized air, is well known.

When oil was used as the medium surrounding the electrodes and test cambric the diminution in apparent dielectric strength with increase in area was always less than with air.

INVESTIGATIONS WITH OTHER THAN BRASS ELECTRODES

A further trial was made with electrodes of leadfoil 0.013 mm. (0.000512 in.) thick, both single and multiple. When a single leadfoil sheet was laid on the cambric test piece and pressed down by a glass plate the diminution in apparent dielectric strength with increase in area was considerable, although not so marked as when a single electrode disk of metal 4 mm. (0.157 in.) thick was employed. Slits were then cut in the leadfoil electrode so as to subdivide its surface into parallel strips connected at one end. This subdivision lowered the diminution to about 2 per cent between the limits 1.1 sq. cm. and 18.1 sq. cm. (0.17 and 2.81 sq. in.) total area, thus corroborating the multiple-electrode test. Incidentally, the application of the high-voltage test caused the leadfoil electrode, or electrodes, to adhere to the test sheet of cambric so closely as to make separation without injury difficult. This adhesive property of leadfoil electrodes may have practical applications.

Fluid mercury electrodes about 2 mm. (0.0788 in.) thick have been tried over the cambric test sheet in place of solid single metallic disks, but without material change in the observed results. That is to say, the diminution in break-down voltage with area was substantially the same as with brass disks. The mercury electrodes were kept in the form of circular disks by means of encircling wooden frames.

Although the above-mentioned observations seem to suggest the existence of very high-frequency oscillations, of the order perhaps of many millions per second, as the principal cause of the diminution in the apparent dielectric strength of cambric sheets with increasing area, yet it must be noted that there has been no direct evidence available to indicate the existence of such high-frequency oscillations.

As an inference from the experiments, whatever opinion may be entertained concerning the ultimate cause of the diminution of apparent dielectric strength with increase in size of metallic-disk electrodes, it is evident that the size used should be standardized. If the electrodes are too small, the electric field between them will not be uniform and the sample of the dielectric test piece will not be sufficiently representative. If the electrodes are too large, the apparent dielectric strength will be unduly small. For practical purposes it is suggested that electrode disks 1 cm. (0.4 in.) in diameter may be used, if the thickness of cambric does not exceed 0.5 mm. (0.0197 in.).

The authors desire to acknowledge their indebtedness to the American Telephone & Telegraph Company for the appropriations under which the research has been carried on, and also to Profs. D. C. Jackson and C. A. Adams, as well as to W. I. Middleton, for valued suggestions. They are especially under obligations to the Electrical Testing Laboratories of New York and F. M. Farmer, the chief engineer, for the execution of the check tests, to which reference has already been made, and for permission to incorporate the results of those tests in this paper.

UNUSUAL STREET-LIGHTING PRACTICE FOR SMALL TOWNS

West Liberty, Iowa, with Population of 1700, Spends $12,000 on Street Lighting with Ornamental Posts and Underground Service

When the town of West Liberty, Iowa, was planning to pave a large percentage of its streets the consideration of adequate lighting also came up for discussion. The streets at that time were lighted by twenty-six arc lamps, spaced with one lamp at each street intersection. It was decided to dismantle this system entirely and install ornamental posts along the seventy-two blocks of street to be paved on 125-ft. centers staggered. For the business district twenty-four posts of the "Continental" design were purchased, and for the residential district 178 "park view" type standards were bought. All circuits were laid underground. Multiple circuits were used for the downtown lamps and series circuits were used for the others.

From the power house to the business district all leads were laid in fiber conduit. The multiple distribution circuits required 2360 ft. (719.3 m.) of three-conductor cable and the series circuits 35,280 ft. (10,755.0 m.) of single-conductor cable. All the cable was No. 6 and No. 10 lead-covered, jute-insulated, steel-taped. The method of laying this cable to secure minimum expense in connection with the paving was as follows: When the paving contractor had "fine-graded" the street and was ready to pour concrete two laborers dug a 6-in. by 6-in. (15.24-cm. by 15.24 cm.) trench and also tunneled small holes under the curb and gutter. The steel-taped cable was then laid in the trench and covered with earth, which was then rolled down by a steam roller. The concrete paving base was then poured.

In making the change from arc lighting to incandescent lighting it was possible by selecting proper sizes of incandescent lamps to reduce the energy consumption over that required before. This made it possible to use the old power-house equipment. The arc lamps registered 20 amp. at 1100 volts on the power-house instruments, and the total load of the new incandescent lamps, with 100-watt units downtown and 100-cp. units in residential districts, is on 17 amp. at 1100 volts. Moreover, the power factor of the latter load is probably better.

The total cost of the lighting system was $12,000. This was paid out of the earnings of the plant, which sells energy to consumers on a straight 10-cent basis. The cost of the paving for the seventy-two blocks was $200,000, so that the lighting seemed inexpensive.

H. L. Dice and George Anderson were the councilmen who fathered the lighting project. Benton R. Anderson was consulting engineer and Louis Ingraham was in charge of electrical construction. The posts were supplied by the George Cutter Company and the other supplies by Chicago jobbers.

Methods of Determining Economical Feeder Sizes

Equations Developed and Curves Plotted to Illustrate How Most Economical Size of Wire May Be Determined When Cost of Energy at Switchboard and Peak Load on Feeder Are Known

BY P. O. REYNEAU*

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WHEN plans are made for building a new line the problem of finding the correct size of wire often does not receive enough attention. Finding the limiting sizes as regards voltage regulation and safe current-carrying capacity is simple, and since these may be the determining factors it is important

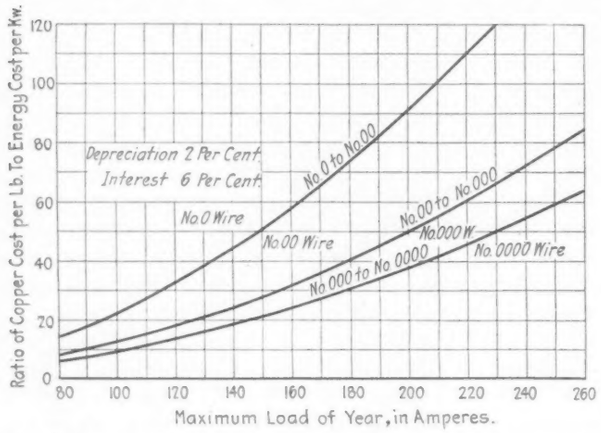


FIG. 1—MOST ECONOMICAL FEEDER FOR ANY RATIO OF COPPER COST TO ENERGY COST, ASSUMING RESIDENCE LIGHTING LOAD

that they should be known. But the consideration which should govern the choice of the wire in most cases is that of economy, and this is not generally so simple of solution. If the problem could always be reduced readily to the classroom form of a definite load at a definite power factor carried continuously for a definite number of hours a day throughout the year, the solution would be simple;. but, unfortunately, the actual case is usually somewhat different. The load on a commercial circuit is very seldom of constant value from day to day throughout the year, nor does it continue for the same period each day, and, to make matters worse, the energy loss varies with the square of the load current, which exaggerates any error in approximation.

It is the purpose of this paper to develop a convenient method of determining the most economical size of wire to be used for any given character of load, and incidentally to show a fairly accurate method of approximating a variable load. The example chosen is that of a number of single-phase circuits having feeders which run from a substation to a central distributing point, so that the current in the feeder will be the same throughout its length. The load on these circuits consists almost entirely of residence and store lighting load and is therefore very suitable for bringing out the effect of the variation of load. The data used were taken from an actual case, and since the character of lighting load is nearly the same in all cities, it should be applicable to almost any circuit carrying purely lighting load.

In these days of fluctuating prices it is rather hard for the engineer to keep pace with the changes. Any calculations which use as their basis a specific price of copper or cost of generating energy are likely to be out of date in a few months. On the other hand, the character of some kinds of load, such as a residence lighting load, is subject to very little change from year to year. Load curves taken on the same date in different years will show approximately the same characteristics, though they may vary in amount. For this reason it has seemed desirable to work out a set of curves which will keep the price of copper and the cost of energy as variable quantities and make it possible to determine the most economical size of wire to be used to carry a lighting load of a given amount for the prices prevailing at the time.

The method of obtaining these curves is as follows: Since the annual charges on a line consist of (*a*) fixed charges and (*b*) energy losses, the most economical size of wire to use for any given condition will be that for which the sum of the above items is a minimum.

Fixed Charges.—There are many factors entering into the cost of installing circuit feeders and thereby affecting the fixed charges, which are the same for any size of wire used, provided the variation is not too great, such as, for instance, the cost of the pole lines, cross-arms, insulators, tie wires, etc. In finding the comparative economy, therefore, these factors may be eliminated and the problem much simplified. In fact, it seems reasonable to assume that the cost on which the fixed charges are figured is made up simply of the cost of the wire plus the cost of stringing it. The fixed charges will, therefore, consist of the cost of the wire plus the cost of stringing it multiplied by the percentage assumed for interest and depreciation. In the present case we have assumed 6 per cent for interest

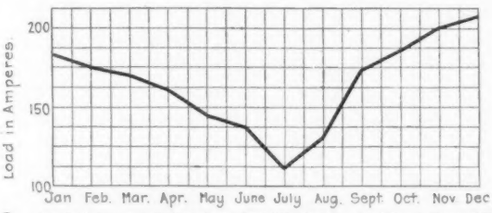


FIG. 2—AVERAGE MONTHLY MAXIMUM LOAD ON LIGHTING-CIRCUIT FEEDERS; PLOTTED FROM OBSERVATIONS OF TWELVE TYPICAL CIRCUITS

and 2 per cent for depreciation, or a total of 8 per cent.

Energy Losses.—The losses in a circuit consist only of the transmission losses or copper losses. These losses will vary with the square of the current carried but will be equal to the sum of all the units lost throughout the year multiplied by the unit cost of the energy at the point of loss. It is the matter of deter-

*The author wishes to express his indebtedness to Harold Cole for his valuable assistance in preparing this article.

mining the amount of this lost energy for a variable load which presents some difficulty, and it is proposed later to show a method of determining it. For the present, however, let us assume that we have reduced the losses to an equivalent loss caused by a certain current carried for a certain number of hours per day throughout the year.

The annual charges may now be represented by the equation:

Annual charges $= (K_1 + K_2)D$,

where K_1 = annual fixed charges per 1000 ft. of line $= (g/100)\ [(2000 \times W \times Cu) + H]$.

K_2 = annual copper loss per 1000 ft. of line $= I^2 \times (\rho/A) \times 2000 \times t \times 365 \times (\text{ener} \div 1000)$.

D = distance of transmission in thousands of feet.

g = per cent interest and depreciation.

W = weight per foot of wire including insulation.

Cu = price of copper wire (including insulation) per pound.

H = cost of stringing 1000 ft. of line.

I = current carried.

ρ = resistivity of wire in ohms per mil-foot.

A = area of wire in circular mils.

t = hours per day for which current is carried.

Ener = cost of energy per kw.-hr.

The formula for the annual charges then becomes:

Annual charges $= [(g/100)\ (2000 \times W \times Cu + H) + 730 \times (\rho/A) \times I^2 \times t \times \text{ener}]D$.

Assuming that for one size of wire $W = W_1$ and $A = A_1$, and for the next larger size $W = W_2$ and $A = A_2$, then:

Annual charges (1) $= [(g/100)\ (2000 \times W_1 \times Cu + H) + 730(\rho/A_1) \times I^2 \times t \times \text{ener}]D$.

Annual charges (2) $= [(g/100)\ (2000 \times W_2 \times Cu + H) + 730(\rho/A_2) \times I^2 \times t \times \text{ener}]D$.

If from these equations the values of annual charges are plotted against values of ener (energy cost) in the above equation, all of the other variables being given particular values, two straight lines will be obtained whose intersection will show the unit energy cost at which, with a given load, the annual charges become less for the larger wire than for the smaller as the cost of energy increases. The intersection may also be determined analytically by solving the two equations for equal annual charges as follows:

$(g/100)\ (2000W_1Cu + H) + 730(\rho/A_1) \times I^2 \times t \times \text{ener} = (g/100)\ (2000W_2Cu + H) + 730(\rho/A_2) \times I^2 \times t \times \text{ener}$.

$$\text{Ener} \times 730 \times I^2 \times t \times \rho[(1/A_1) - (1/A_2)] = 2000\ (g/100)\ Cu(W_2 - W_1) + gH - gH.$$

$$\text{Ener} = \frac{20gCu(W_2 - W_1)}{730 \times I^2 \times t \times \rho[(1/A_1) - (1/A_2)]}$$

The same thing which was done for energy cost may also be done for copper cost and the following equation will result:

$$Cu = \frac{730 \times I^2 \times t \times \rho[(1/A_1) - (1/A_2)]\ \text{ener}}{20g(W_2 - W_1)}$$

In the above equation ρ, A and W are fixed for the different sizes of wire, g is assumed, and t is determined by the character of the load. Therefore for any particular kind of load the only variables to be considered are the price of copper, the cost of energy and the amount of the load (Cu, ener and I).

If I is given particular values in this equation, the equation becomes that of a straight line which is the locus of the intersections as described above for various prices of copper and of energy. All points above the line indicate that the smaller wire is the most economical and all points below indicate the larger. Since for any value of I then the equation between Cu and ener is a straight line, the slope of that line is constant for any value of I. Hence the slope of these lines which is Cu/ener may be plotted against values of I. Rearranging the last equation, therefore,

$$\frac{Cu}{\text{ener}} = \frac{730 \times t \times \rho(A_2 - A_1)}{20g \times A_1 \times A_2\ (W_2 - W_1)} \times I^2.$$

The curves for the specific case chosen for this example have been plotted from the preceding equation for four different sizes of wire in Fig. 1. Each curve is the locus of points at which, for different ratios of copper cost to energy cost, the economy changes from the smaller to the larger as the current is increased. Any point above the curve indicates that the smaller wire is the more economical; any point below, the larger. The areas between lines therefore show the range of values for which any one size of wire is the most economical.

The I^2R loss in a circuit is due to a certain current I flowing through a certain resistance R for a certain

TABLE I—MAXIMUM MONTHLY CURRENT READINGS ON TWELVE TYPICAL CIRCUITS

Circuit	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1	190	180	180	175	160	135	120	125	160	175	180	195
2	200	180	175	165	145	140	110	130	200	195	205	210
3	175	165	150	140	120	125	90	115	160	165	180	185
4	185	175	180	150	140	140	105	130	175	185	200	210
5	155	155	155	150	135	130	100	130	160	175	180	195
6	150	140	135	125	110	100	90	80	120	135	150	150
7	245	225	210	200	190	180	120	140	225	245	285	285
8	235	225	225	210	200	185	150	205	250	280	280	280
9	225	225	215	225	175	175	135	170	215	235	240	250
10	185	185	185	175	150	140	130	140	170	185	225	240
11	125	120	115	110	105	105	90	100	120	125	135	150
12	130	120	110	105	100	100	85	100	125	135	145	130
Total.....	2200	2095	2035	1930	1730	1645	1325	1565	2080	2235	2405	2480
Average of the twelve.....	183	175	170	161	144	137	111	130	173	186	200	207

TABLE II—EQUIVALENT HOURS PER DAY AT PEAK LOAD

Month	(1) Equivalent Hours at Peak Load	(2) (Peak for Month) / (Peak for Year)	(3) (Peak for Month)^2 / (Peak for Year)	(1 × 3)
January.....	5¼	0.884	0.781	4.10
February.....	4½	0.845	0.714	3.21
March.....	3¼	0.820	0.672	2.185
April.....	2¾	0.778	0.606	1.67
May.....	2¼	0.695	0.483	1.088
June.....	1¾	0.662	0.438	0.767
July.....	2	0.536	0.287	0.574
August.....	2½	0.628	0.395	0.987
September...	3¼	0.835	0.697	2.263
October.....	4	0.898	0.806	3.224
November...	5	0.965	0.931	4.655
December...	5½	1.000	1.000	5.500
Total.....				30.223
Average...				2.519

$t = 2.519 \times (0.95)^2 = 2.27$ equivalent hours per day at peak load.

length of time. In this case R is fixed by the size of the wire under consideration, but I is variable. It is more convenient, however, to assume a constant value for I which, flowing for a certain number of hours, would cause an equivalent loss to that due to the variable I on a typical circuit throughout the year. Any value might be assumed for I and the equivalent number of hours could be computed accordingly, but it is most convenient to assume I as the maximum value of the current for the year or yearly peak, since this is a critical value which must not rise above a certain limit and should be carefully recorded for any circuit.

The equivalent number of hours which may be used with this maximum current is obtained as follows: The characteristic variation of the load on any circuit from month to month can be obtained from Table I, giving maximum current readings for each month during one year on twelve typical circuits in various districts and with various loads.

The curve (Fig. 2) plotted from the preceding average values indicates clearly the variation of the monthly peak loads on a typical circuit. Since the peak for the year occurs in December, the peak for any month may be expressed as a fraction of this yearly peak as follows: January, 0.884; February, 0.845; March, 0.820; April, 0.778; May, 0.695; June, 0.662; July, 0.536; August, 0.628; September, 0.835; October, 0.898; November, 0.965; December, 1.00. Hence, for example, the maximum current for February equals 0.845 multiplied by the maximum current for the year, etc.

For convenience the I^2R loss for any month may be considered equal to the loss for a typical day in the month times the number of days in the month, since the variation of load from one month to the next is not enough to warrant more detailed computation.

The I^2R loss in a feeder for any one day would be very nearly equal to the sum of the squares of the current readings for each hour during the day multiplied by R. For a great part of the day, however, the load on a lighting circuit is very light, the heavy load and hence most of the loss occurring within a few hours in the evening. By adding the squares of the hourly current readings throughout a day and dividing by the square of the maximum current for the day a figure is obtained which represents the number of hours for which the peak load for the day would have to be carried steadily to produce the same I^2R loss.

For a strictly accurate calculation enough data should be available to make it possible to determine the shape of the load curve on a typical circuit for one typical day for each month in the year. If this be not possible, however, a fairly accurate approximation may be arrived at if the load curves for only one or two months are available. If the equivalent number of hours at peak load for a typical day for these months is determined, the equivalent hours for the other months may be calculated more or less accurately by making them proportional to the number of hours between sunset and about 10 p. m., allowing a little additional time in the winter months for the morning lighting peak. The figures obtained in the present case for these monthly equivalent hours at peak load will be found in the second column of Table II.

Since the loss for any day in a month is proportional to the square of the maximum current for the day multiplied by the equivalent hours per day at peak load as obtained above, the loss for this day = (maximum current for the month)$^2 \times (0.95)^2 \times$ equivalent hours per day at peak load $\times R$, if it is assumed that the average daily peak will be 95 per cent of the peak for the month. The monthly peak, however, is equal to a certain fraction of the yearly peak, so the loss for this day = (maximum current for the year)$^2 \times$ (fraction for the month)$^2 \times (0.95)^2 \times$ (equivalent hours per day at peak load for that month) $\times R$. For example, the equivalent hours per day for February are four and one-half. The peak for February is 0.845 of the yearly peak. Hence for a typical day in February the I^2R loss = (yearly maximum current)$^2 \times (0.845)^2 \times (0.95)^2 \times 4.5 \times R$. But the (yearly maximum current)$^2 \times R$ will be the same for any particular circuit, so that in finding the equivalent hours for the year that part of the above equation may be neglected. The quantity $(0.95)^2$ is also a common factor. This leaves only two items which vary from month to month, the equivalent hours at peak load for each month and the ratio of the peak for the month to the peak of the year. The square of the latter multiplied by the former will give a weighted value of equivalent hours for each month the average of which multiplied by $(0.95)^2$ gives the number of hours per day throughout the year for which the yearly peak load would have to be carried to produce a loss equivalent to that caused by the actual variable load. This value has been worked out by means of the data tabulated in Table II.

The value just obtained for t has a real significance, as it means that for the purely lighting load assumed the peak load for the year will be carried for about two and one-quarter hours each day. As pointed out before, these data should check closely with a set of data taken on almost any city lighting circuit and should be applicable to any lighting circuit feeder. Knowing the price of copper, the cost of energy at the substation switchboard and the maximum current for the year to be expected on any such feeder, the most economical size of wire may be determined readily from the curves in Fig. 1.

It is naturally possible to work up similar curves for feeders carrying a load of different character; in other words, to determine I and t for those circuits and then use the equation given above to obtain the curves.

Electric Lighting Plants in Costa Rica

United States Vice-Consul Albert B. Pullen, writing from Port Limon, Costa Rica, says that in that district there are eighteen towns and villages with populations of 200 and upward. There are two electric lighting plants in the district—at Port Limon and at Siquirres. The plant at Port Limon is owned and operated by the United Fruit Company, with H. O. Easton as superintendent and E. E. Mullens as manager. Inside of buildings the wires are visible, being usually suspended from the ceilings by lamp cord. The plant at Siquirres is known as Compañia de Luz Electrica de Siquirres, with N. A. Finlay as manager. The wires, both inside and outside, are strung as at Port Limon. There is a small market in this district for electrical goods and supplies. Very few fixtures are used, and the imports are limited to equipment and supplies necessary for the maintenance and upkeep of the plants.

Types of Motors Designed for Different Loads

Importance of Good Commutation and How It Is Secured—Industrial Applications to Which Different-Type Motors Are Adapted—Changing Speed Ratios by Mechanical Means

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

SYNOPSIS.—This article is a continuation of the discussion in the last installment on the elements of speed, torque and power in machine-tool motor work. Typical operations are considered on the basis of which the principal types of motors available at present may be grouped according to their operating characteristics. Reference is made to the advisability of using mechanical methods for changing speed in connection with constant-speed motors where an adjustable-speed equipment might at first seem the only choice. The principal steps which have been taken to improve commutation for direct-current industrial motors are outlined and considerable emphasis is placed upon the relatively wide field for alternating-current motors of various types. Frequent references are made throughout the article to the developments in motors of the various classes, so that the present discussion is of fundamental interest to those who are actively engaged in the motor application field.[1]

SINCE commutation has been perhaps the principal limitation to the satisfactory operation of the direct-current motor in the past, the steps which have been taken to improve commutation assume an unusual degree of importance from the practical standpoint of motor application work.[2]

Classified according to design features which improve commutation direct-current motors fall under the heads of (a) the non-commutating-pole, (b) the commutating-pole, and (c) the compensated motor. In the first class the problem of successful commutation has been approached more or less indirectly, with the result that satisfactory conditions may be produced for one given load with somewhat less favorable results at other loads.

A. C. Lanier points out that the chief steps which are responsible for successful commutation in motors of the first class are the tendency to use shallow and broad slots, decreased lengths of the armature core, reduced turns per armature coil, a higher ratio of air-gap field ampere-turns to the armature distorting ampere-turns, relatively flat neutral and high contact-resistance (carbon) brushes. This summary points to the various items which bear on the commutation problem, and it furnishes a comprehensive idea of the channels through which marked improvements have been made possible in modern motors of this type in comparison with earlier equipment.

The difficulty in the way of compensating for the shift of the commutating coils of such motors into the regions of reduced flux from the main poles is illustrated in Fig. 1, which has been based on a somewhat similar diagram by Lanier. From this diagram it is seen that the correct value (approximately) of the flux for successful commutation and for a given speed, and hence a given field excitation, obtains at one value of armature amperes (load) only, *i.e.*, at *a*. For another value of field current made necessary, for example, by a required change in speed, the load current for the approximately correct flux value is at *b*. In this diagram, at loads greater than *c*, the resulting flux reverses and aggravates sparking, similarly at *d* for the lower field current. These features depend, of course, on fixed brush position and indicate the difficulty of adapting the ordinary non-commutating-pole motor to loads where wide speed adjustment is necessary. Of course, this condition is aggravated where, owing to reversing service, a neutral brush setting is required.

The points mentioned have only a limited bearing on the motor-application problem; however, their importance is greatly increased when it is considered that the commutating-pole motor has made possible (at least to a considerable extent) the wide speed range found impracticable with the non-commutating-pole type. It should also be noted at this point that in the so-called compensated direct-current motor with its distributed auxiliary field winding in series with the armature current the practical elimination of field distortion has been accomplished for the higher-voltage motors which are applied to operations with a heavy reversing duty cycle.

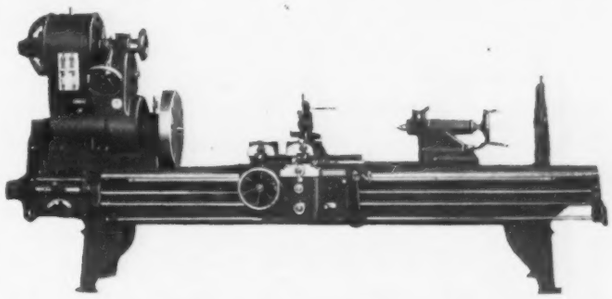


FIG. 1—HEAVY-DUTY LATHE EQUIPPED WITH MOTOR LIKE THAT IN L, FIG. 3

The principal characteristics to be observed in the motors for (a) constant speed and continuously running drives with small variations in load, (b) non-reversing and continuously running drives with large variations in load, and (c) reversing operations, are summarized in Table I. These are discussed at length in the paper previously referred to (see footnote 1).

INDUSTRIAL APPLICATIONS FOR DIFFERENT ALTERNATING-CURRENT MOTORS

Of the three general types of alternating-current motor—the induction motor, the commutator motor and the synchronous motor—the first-named constitutes the widespread and important type. A lesser number of applications of the other two types, although important ones, exist in certain classes of service. The induction

[1] This discussion is fundamentally a review of present aspects of the industrial motor situation. As such, frequent reference has been made to various sources, including data submitted by leading motor manufacturers. Hence individual references are not made in all cases in the text to the source of the information, except in a few special instances, which are covered by appropriate footnotes.

[2] See discussion by A. C. Lanier, *Transactions A. I. E. E.*, Vol. 34, pp. 176 to 196.

motor,[3] in the ordinary sense of the term, is a constant-speed unit possessing characteristics similar to that of the direct-current shunt motor in load and speed. As such its field of usefulness lies largely in that class of applications coming within constant-speed operation. This statement is, of course, general, and allowance must be made for the fact that the induction motor may be made to come under the variable-speed class by introducing extra rotor resistance, or under the adjustable-speed class to a limited extent by changes in the polar connections or other arrangements.

In general the constant-speed-type induction motor is adaptable to practically all classes of service where the straight direct-current shunt motor is applicable. However, even under such circumstances there is sometimes a preference for the induction motor, although either might be used from the standpoint of the supply, for example in such cases as steel-mill drives. The constant-speed induction motor has the advantage of ruggedness, and, of course, does not present commutation troubles.

The very extensive possible applications of induction motors to industrial purposes is evidenced by the fact that in tables compiled to show the types of motors which may be used for a variety of machines the induction motor covers a large part of these uses. Thus, in twenty-nine different machine tools as listed in the "Handbook for Electrical Engineers" (page 893) the induction motor is listed as suitable for every case, with the obvious provision that in many of these cases where adjustable speed is required mechanical speed-changing facilities are provided.

Principal Uses of Synchronous Motors

The early difficulties of starting, hunting and direct-current excitation experienced with synchronous motors are no longer of such great importance with the modern motors of this class because of marked improvements in design for the first two items and the general availability of direct-current supply in most factories and other places where they might be employed.[4] The principal uses of the synchronous motor are for loads requiring no adjustments in speed, from which it follows that one of its chief points of usefulness is for machinery where highly constant speed is required. It may also be used for driving slow constant-speed machinery and in those cases where power-factor correction is the special feature, mechanical power being sometimes drawn from the machine at the same time.

Carl J. Fechheimer summarizes the practical uses of the synchronous motor from the mechanical standpoint as including the driving of line shafting where the starting torque is not more than 50 per cent of the normal motor rating, centrifugal pumps and fans where the pull-in torque near synchronous speed is at or below 40 per cent of normal rating, alternating-current and direct-current motor-generator sets, frequency-changer sets, low-speed air compressors, and as a synchronous condenser. This list indicates little or nothing of interest to machine-tool applications, although several references may be made later on to one or another of the special uses of this motor in the more general field of industrial applications.

[3]An interesting discussion of induction-motor characteristics by A. E. Averrett is found in *Transactions A. I. E. E.*, Vol. 34, p. 223.

[4]Several references are made to a discussion by C. J. Fechheimer, *Transactions A. I. E. E.*, Vol. 34, p. 213.

The synchronous motor may be started either as an induction motor[5] or by means of a small auxiliary motor used to bring the speed of the main motor up to a value slightly above synchronous speed, after which it may be thrown on to the supply circuit by synchronizing. The last-named method is recommended where the motor must be started frequently through the average day. The first method requires a squirrel-cage induction-motor winding on the pole faces of the motor, which must be carefully designed as to cross-section if the proper starting torque is to result.

The alternating-current commutator motor possesses some interesting features in the industrial applications field. There are two important reasons for the use of

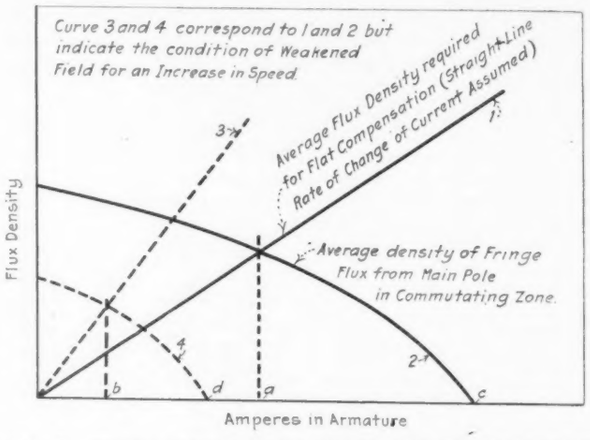

Curve 3 and 4 correspond to 1 and 2 but indicate the condition of Weakened Field for an Increase in Speed
Average Flux Density required for Flat Compensation (Straight Line Rate of Change of Current Assumed)
Average density of Fringe Flux from Main Pole in Commutating Zone
Flux Density
Amperes in Armature
a
b
c
d

FIG. 2—CURVES ILLUSTRATING DIFFICULTY OF COMPENSATING FOR COIL SHIFT IN NON-COMMUTATING-POLE MOTOR

this type of motor which are more or less easily confused, although both may apply at the same time to some given motor applications.[6] They are (a) that the commutator makes high starting duty possible on single-phase circuits, and (b) that the commutator makes variable-speed operation possible with the alternating-current motor. These advantages may, however, be completely offset by the higher first cost of this type of motor.

E. F. W. Alexanderson takes the stand that there is a tendency for the motor operator who has used variable-speed direct-current motors (adjustable-speed shunt characteristics implied) to consider that the adjustable-speed characteristics are essential to meet the needs of his machine, whereas many cases have demonstrated the fact that the characteristics of the variable-speed alternating-current motor have been very well able to cover the requirements, in spite of the preliminary conclusion that the characteristics of the adjustable-speed direct-current shunt motor were essential.

Hence some caution is desirable in the promiscuous recommendation of the more expensive equipments of the last-mentioned type, and it should be kept in mind that this choice is not warranted unless its added expense in comparison with the cost of a variable-speed

[5]Still another method of starting which may be mentioned is through the action of the hysteresis and eddy currents set up in the field poles by the rotating field of the rotor, *i.e.*, when the field winding of the synchronous motor is open-circuited and the machine is of the polyphase type with the latter connected to the alternating-current supply mains. This method is not ordinarily practicable owing to the low starting torque produced. For additional information on synchronous motor starting, see the "Handbook for Electrical Engineers," pp. 1023 and 1025.

[6]A discussion at some length on the uses of this type of motor by E. F. W. Alexanderson is found in the *Transactions A. I. E. E.*, Vol. 34, p. 212.

FIG. 3—SOME TYPES OF MOTORS SUITABLE FOR CONSTANT AND ADJUSTABLE SPEED WORK

A—Direct-current adjustable-speed motor for reversing-duty cycle. B—Commutating-pole-type crane and hoist motor. C—Commutating-pole motor available in sizes from ½ hp. to 75 hp. D—Rolling-mill motor. E—Squirrel-cage three-phase induction motor. F—Single phase split-phase start induction motor. G—Motor equipped with back gear. H—Fully inclosed three-phase induction motor with brake. J—Vertical single-phase motor (5½ hp.). K—Single-phase motor with slide-rail attachment. L—Adjustable-speed motor employing change of reluctance in magnetic circuit

motor of the series type or equivalent is offset by clearly defined advantages.

Special Types of Motors

A number of types of motors are on the market whereby wide speed adjustment is possible by variations in the reluctance of the magnetic circuit. These must be distinguished from those discussed in the foregoing notes as they make use of a method distinct from that in the ordinary direct-current shunt motor of the adjustable-speed type with field control.

In one commercial motor of this type unusually wide adjustment in speed is permitted by lateral movement of the armature with respect to the pole pieces. The armature is cone-shaped and pole pieces are designed to correspond so that a small lateral motion of the armature will greatly increase the air gap and hence decrease the flux. While the adjustable-speed direct-current shunt-field-control motor is commonly designed for no greater speed adjustment than a ratio of four to one (maximum to minimum speed), the ratio is as high as ten to one in commercially practicable motors of the type described.

PRINCIPAL MOTOR-OPERATING CHARACTERISTICS OF INTEREST IN VARIOUS CLASSES OF INDUSTRIAL SERVICE

Service	Constant speed; continuous running; infrequent shut-down; moderate variations in load	Non-reversing; continuous running; wide cyclic load variations; excess duty peaks	Reversing duty cycle
Factors Requiring Special Consideration	1. Speed torque 2. Commutation 3. Stability 4. Heating 5. Ventilation 6. Efficiency	1. Speed torque 2. Commutation 3. Inertia 4. Heating 5. Ventilation 6. Efficiency	1 Speed torque 2. Commutation 3. Inertia 4. Stability 5. Heating 6. Ventilation 7. Mechanical construction

Subsequent discussions will show that many actual cases of machine-tool applications can be amply provided for by a speed ratio of four to one, and in such cases it follows that these higher speed ratios would hardly provide any additional advantage over the smaller ratio. However, the gradual changes in speed of the adjustable-field-reluctance motor form an interesting and important consideration for this type, and, of course, those cases where higher speed ratios than four to one are required would be especially well covered by this type.

Changing Speed Ratios by Mechanical Means

From what has been said it follows that the usefulness of constant-speed motors for industrial applications requiring speed changes rests almost wholly on the availability of mechanical speed-changing devices such as the cone pulley or the gears now commonly employed. Furthermore, where the gradations in speed are not sufficiently close with such mechanical auxiliaries it follows that the adjustable-speed motor possesses its great advantage. There is no hard-and-fast rule for covering all cases. In fact, one of the most important phases of this work relates to the determination of this very point as a dividing line or limit to the use of the constant or nearly constant speed motor. It has also been mentioned in this same connection that sometimes this dividing line is rendered less distinct by the possibility of using one or another of the variable (series characteristic) motors in place of those of the adjustable-speed (shunt characteristic) type.

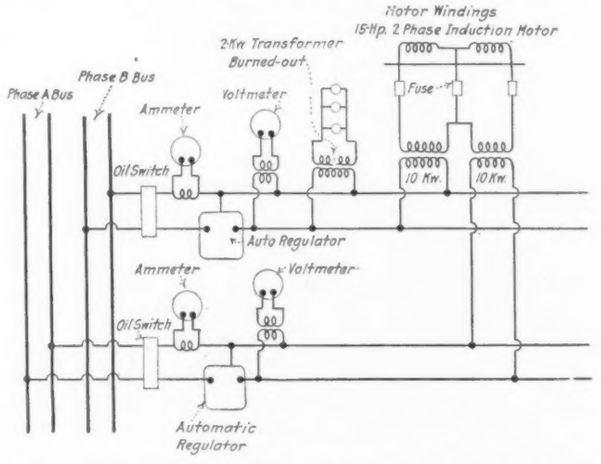
PECULIAR CASE OF VOLTAGE ON SUPPOSEDLY DEAD FEEDER

Two-Phase Induction Motor Operating Single-Phase Pumps Energy Into Other Phase of Circuit

BY E. CHARLES SEARES

Some time ago the writer's attention was called to a peculiar case of voltage on a supposedly dead feeder. The circuit involved was part of a 2200-volt, two-phase, four-wire distributing system supplying service to residences and an electroplating factory. During the night a short circuit occurred (later traced to the burning out of a 2-kw. single-phase lighting transformer), opening the station oil switch on phase *B*. This was not noticed, however, as the oil switch was of the type in which the handle does not show when the switch has been opened automatically and because there were no pilot lamps or signals to indicate the fact either.

During the course of the evening when the station attendant read his meters he noticed that the voltage



CONDITIONS EXISTING WHEN OIL SWITCH OPENED, CAUSING INDUCTION MOTOR TO OPERATE SINGLE-PHASE

across this phase was lower than normal. Later on the voltmeter showed no reading, and it was then that the operator first noticed that the oil switch was open.

On investigating the trouble and endeavoring to explain the low voltage prior to the complete interruption to service on phase *B* it was decided that a two-phase induction motor which runs all night at the electroplating factory had operated single-phase after the opening of the phase-*B* oil switch but had energized phase *B* by acting as a generator. In the early morning, when customers began turning on their electric lights, the load became too great for the motor, and the fuses opened, causing the first indication at the station of the open oil switch in phase *B*. The motor had been able to operate single-phase without blowing its fuses as long as it did because it was rated at 15 hp. and only carried a load of 10 hp., not including the small amount of power it had been supplying to phase *B*.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

FOUR-WIRE OPERATION HELPED BY GOOD GROUNDS

Grounding of Neutral at Numerous Points Essential to Prevent Single Transformers Being Supplied from Floating Section of Neutral

BY S. B. HOOD

The chief requirement for successful operation of four-wire, three-phase star systems is the maintenance of good grounds on the neutral. A number of companies are grounding the neutral wire only at substations and are having a considerable amount of trouble. This method of depending upon a single ground is not the proper one to use. The neutral wire must be grounded at numerous points throughout, being so placed that in no case can a broken neutral wire leave even a single transformer bank supplied from a floating section of ungrounded neutral. These grounds must be made by connecting two water pipes, as driven-pipe grounds are not generally of low enough resistance to give satisfactory results. Where water-piping systems are not available for grounding it is doubtful whether the four-wire star system gives as good operating results as the older delta system. Fortunately, however, few towns of any size are to-day without their water-supply system, and little opposition need be expected to the use of these pipes for grounding, as it has been conclusively proved that no injury to the pipes will result. This method is now recommended by both the National Electric Code and the National Electrical Safety Code.

A still further refinement of the four-wire, three-phase system is that of using a common grounded neutral. This system is being used quite extensively both in some of the larger Canadian cities and in cities of the United States. Broadly speaking, it consists of using a fair-sized interconnected grounded single-wire network covering the entire district to be served. This network is thoroughly grounded at many points and is used commonly as a grounded neutral in both primary and secondary systems. The grounds can best be made by grounding each individual service to the water piping on the customer's premises. This insures individual protection to each and every customer.

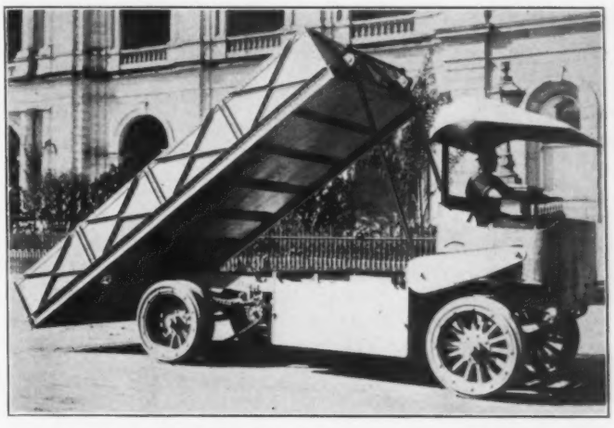
This system has been used for a period exceeding six years in a city of more than 500,000 population distributing about 20,000 kva. for lighting and power purposes. During this period it has been proved to be by far the most economical and reliable of all systems of distribution. On this network very few lightning arresters are installed, although it is in a district subjected to very severe lightning disturbances. One year's record showed only six transformer failures out of a total of approximately 1800 transformers, or about one-third of 1 per cent. In this same district there is a competing delta-connected network, giving an excellent opportunity for comparison between the two systems under the same conditions of exposure.

In one severe lightning storm the delta system was completely put out of service, having nearly every transformer fuse blown in spite of the fact that each transformer had its own set of lightning arresters installed. About thirty transformers were burned out completely. The star-connected common-neutral system went through without any interruption, although fuses were afterward found to be blown in three transformers feeding into the interconnected secondary network.

SELF-DUMPING ELECTRIC COAL-DELIVERY TRUCK

Has a Range of 45 Miles at a Speed of 7 Miles per Hour and Handles 50 Tons Daily, Replacing Eight Tip Drays

The City Electric Light Company, Ltd., Brisbane, Australia, has put into service a 5-ton electric self-tipping lorry for carting coal from the coal chutes to its power station, a distance of approximately 1¼ mile (2 km.). The lorry, which weighs about 10 tons when loaded, is propelled by an electric motor operated from a forty-four-cell "Exide" storage battery. Its range when loaded is 45 miles (72.42 km.) on one charge, with a speed of seven miles (11.26 km.) per hour.



COAL TRUCK THAT REPLACES EIGHT TIP DRAYS

The body of the lorry can be elevated to an angle of 45 deg. and is therefore self-emptying. The elevating of the body is done by a 3-hp. motor which is gear-connected to two vertical screws. Less than one minute is required to reach maximum elevation. The lorry and its driver are now handling 50 tons of coal daily and have replaced eight trip drays. The average consumption of electricity by this lorry, taken over one month, was 2.43 units per mile of route. The chassis was made by the General Vehicle Company, but the body and gear were designed and built in Brisbane.

OPINIONS ON PRESENT UNDERGROUND PRACTICE

Ohio Operating Men Call Attention to Types of Construction Which They Have Found Give Best Service

According to opinions expressed at a recent meeting of the transmission and distribution committee of the Ohio Electric Light Association in Cleveland, brick is considered as having an advantage over concrete for manholes when speed of construction is taken into account. However, it does have the disadvantage that the construction of a manhole of this type requires skilled labor. When using collapsible sectional forms, however, a manhole can be installed by ordinary labor. Concrete is best in gravel or sandy soil where sheeting would be necessary anyhow. A concrete bottom is not recommended unless sewer connection is provided. G. W. Wenzel of the Northern Ohio Traction & Light Company, Akron, stated that the cost of 8-ft. by 7-ft. 6-in. by 6-ft. 8-in. (2.43-m. by 2.28-m. by 2.02-m.) deep standard concrete manholes was $125 complete.

W. E. Salber of the Northern Ohio Traction & Light Company pointed out that fiber is more flexible than clay, that it is easier to install, that the joints are more certain to hold, and that by laying the fiber in a band of concrete a solid mass can be obtained which will permit of a limited amount of moving of the complete mass without injury to the cable. Considerable difference of opinion existed regarding the relative ease of pulling cable into fiber and clay ducts. It was thought that the clay duct, if properly cleaned, would afford an easier surface to pull over than the fiber. However, the possibility of raised unglazed portions being present in clay ducts makes the pulling of cable in such duct a trifle more difficult than in fiber.

F. M. Hibben, Cleveland Electric Illuminating Company, stated that radiation depends a great deal upon the condition of the soil and the amount of moisture therein. Paved streets hinder the radiation of heat from cable beneath because water does not get into the soil so easily. R. J. Feather, Columbus (Ohio) Railway, Light & Power Company, explained one instance where he found it necessary to use forced draft by means of a 0.25-hp. motor-driven blower together with two pipe connections carried to the surface at the curb, one for intake and the other for exhaust. It was thought that the fiber was more or less detrimental to the radiation of heat.

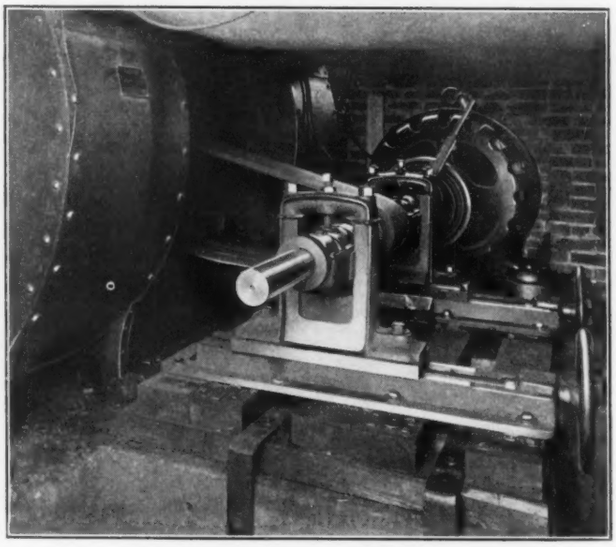
A very economical method of fireproofing cables in manholes was described. It consists of using a 3-in. (7.62-cm.) strip of cheesecloth tape bound around the lead sheath. A stiff sand cement is forced between the cheesecloth and the cable to a thickness of about 1 in. (2.54 cm.). The cost of this fireproofing amounted to approximately 18 cents a foot (60 cents a meter). This covering is fairly flexible.

In the round-table discussion of high-tension cables, joints, etc., F. M. Hibben said that the adoption of a standard-size cable containing No. 4/0 B. & S. conductors for all work has proved an advantage in making the system very flexible. Considerable emphasis was laid upon the necessity of installing underground cables while warm in order that the cracking of insulation might be eliminated. C. D. Fitch, Toledo Railways & Light Company, said that it has been noticeable that failures do not occur during peak loads. They usually occur at light loads. This was explained by the fact that the carbonization of the dielectric due to heat continues after the load is removed, when breakdown is very likely to be augmented by excess voltage due to light load.

SYNCHRONOUS MOTOR FOR DRIVING AIR BLOWER

Power-Factor-Corrective Ability of Motor Used to Compensate for Small Squirrel-Cage Motors Elsewhere in Plant

A somewhat unusual application of a synchronous motor, but one that is being used more and more extensively as the advantages of power-factor correction become more generally appreciated, is shown in the accompanying illustration. The motor, which is a 70-hp. Westinghouse machine, operates a blower consisting of two 60-in. (152.4-cm.) fans in the exhaust system of a large shoe factory. Originally the blower was driven by a 50-hp. squirrel-cage motor. While this was entirely satisfactory as far as operating the blower was concerned, conditions elsewhere in the factory made the change to a synchronous motor highly desirable.



BLOWER MOTOR THAT COMPENSATES FOR POOR POWER FACTOR OF OTHER AUXILIARY MOTORS

The factory has its own power plant and contains about 200 hp. of squirrel-cage motors, none of which (with the exception of the blower motor) is larger than 10 hp. All of these small motors run at light load most of the time, since a shoemaking machine, even when in constant use, is loaded intermittently only. In consequence, the power factor of the electrical system was low, rarely exceeding 70 per cent and often falling to nearly 60 per cent, and this caused the generator and exciter to overheat even under light loads and seriously affected the voltage regulation.

The use of a synchronous motor to raise the power factor was, of course, the proper remedy, and it was applied to the blower, since the blower offered the only large, uniform and continuous load in the factory. The

synchronous motor had to be larger than the original induction motor so as to provide additional capacity for power-factor correction. With its use the power factor is maintained at 98 per cent, which greatly improves the operation of every piece of electrical apparatus in the plant.

Since the synchronous motor does not have sufficient starting torque to bring the blower up to full speed, it is necessary to use a clutch, by means of which the load is thrown on the motor after it reaches full speed. The motor is controlled from the power house, the starting switch, field rheostat and power-factor meter being mounted on one of the panels belonging to the main switchboard of the plant.

TRANSFORMER RECORD CARD USED BY WESTERN COMPANY

One Side of the Card Gives the History of the Transformer Service, the Other Records Test Data and Condition of Oil

Reproduced below is a transformer record card that has been used for several years with success by a Western company. The two sides of the card are shown, one side giving a complete record of the life of the transformer and the other side test information and condition of oil. It will be noted that the form

TRANSFORMER RECORD

MAKE	TYPE	MAKER'S No.	COMPANY'S No.
G. E.	H, Form G	1371416	2563

VOLTS: PRIM 11000 10500 - 10000; SEC. 2300 - 460 — CAPACITY K. W. 50 — DATE RECD 4-7-15

STATION No	INSTALLED Mo. Day Yr.	REMOVED Mo. Day Yr.	REMARKS
7146	5 1 15	10 7 15	
9011	11 2 15	1 3 16	Primary Bushing Broken
61700	2 2 16		

TEST RECORD

DATE	WATTS CORE LOSS	AMPERES EXC. CUR.	INSULATION VOLTS	RATIO	REMARKS
4-9-15	248	.043	22000	OK	
10-10-15	245	.040	22000	OK	
1-8-16	245	.041	22000	OK	Repaired Primary Bushing

OIL RECORD

DATE CHANGED	REMARKS
10-10-15	
1-8-16	Flushed Coils

FORM OF TRANSFORMER RECORD AND TEST SHEET USED BY WESTERN COMPANY

records exclusively information with reference to the transformer. Information concerning the load connected to a transformer after it is installed is put on a second card file, which contains transformer station numbers, arranged numerically, whereas in the transformer card file the transformers are arranged numerically by company number. A cross reference between these two files is in the one case the transformer number and in the second case the station number. Station numbers are arranged in such a way that the number tells at a glance the district and feeder to which the transformer is connected. The company number appears on the cover and side of each transformer in white letters 2½ in. (6.4 cm.) high, easily legible and not likely to be obliterated.

REVERSED PHASE CAUSES SUBNORMAL MOTOR SPEED

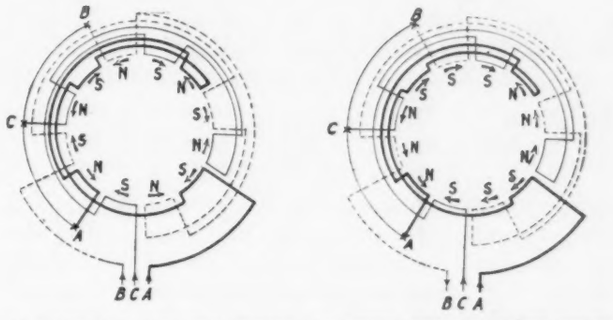
How the Abnormal Operation of a Reconnected Motor Was Traced to a Wrong Connection of One Winding

BY M. M. CLEMENT

While working in a power plant in a small Western town the writer had to reconnect a three-phase, four-pole, series star-connected motor so it would operate at a different voltage. Changes were made according to blueprints, but when the motor was tested it operated at only about one-third normal speed.

To locate the trouble the star connection was opened and opposite ends of each phase were joined to the terminals of a storage battery. By testing the poles of the armature with a small pocket compass while current was flowing in this manner it was found that the poles of each phase were symmetrically placed around the armature and that they were alternately marked "south," "north," etc., just as they should have been.

Next the star connection was joined again and current allowed to flow in two leads and out the third. Under this condition and with a properly connected three-phase, four-pole motor the polarity of three consecutive poles should be in one direction (Fig. 2), while that of the next three should be opposite, etc., thereby forming four flights of alternately different polarities.



CONNECTIONS AND POLARITIES AS THEY SHOULD HAVE BEEN IN MOTOR WHICH WAS REWOUND

In this motor, however, it was found that the adjacent pole faces had opposite polarities, indicating that one phase was reversed.

To determine which was reversed all of the leads were connected with the positive terminal of the storage battery, while the star connection was joined with the negative terminal. Under these conditions in a properly connected armature the polarities of adjacent poles should be opposite, but in this motor three consecutive poles had similar polarities, while the next three had the opposite polarity, etc. Since the only polarities that could be reversed to bring about the proper arrangement were those corresponding to phase *B*, it indicated that this phase had been reversed; that is, the terminal which should have been a lead was connected to the star point and vice versa.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

GAIN OF 60 PER CENT IN NEW-BUSINESS SALES

Scarcity of Domestic Labor Has Resulted in Greatly Increased Appliance Sales by the Doherty Organization

Sales by the new-business department at the Doherty properties are one-half again as much as in 1916, according to a statement made by George Williams, manager of the new-business department of the organization. Mr. Williams said that the growth this year was typified by the September figures, which showed appliance sales amounting to $151,000 for the month as compared with $90,000 for September, 1916.

In commenting upon the increased sales, Mr. Williams pointed out that the war was chiefly responsible for the greatly increased demand for electric and gas appliances. He said the war, in causing a scarcity of labor in all branches of work, had not overlooked domestic workers, with the result that servant girls were scarce. This scarcity of servants has made the housewives of the country do their own work, and they have tried to simplify that work as much as possible. For that reason the labor-saving gas and electric appliances have been in great demand, with the consequent benefit to new-business sales.

CITY MANAGEMENT DOES NOT MEAN MUNICIPAL OWNERSHIP

H. M. Waite, City Manager of Dayton, Ohio, Lays Down Reasons for Co-operation Between Utilities and Municipalities

Co-operation between communities and utilities will solve the difficulties the former have in getting service and the latter in making a living, according to H. M. Waite, City Manager of Dayton, Ohio, who discussed the subject at the recent city managers' convention at Detroit. Part of his remarks are abstracted below:

Undoubtedly many have the idea that city management means municipal ownership. There is just one thing in which communities are interested jointly with utilities, and that is service. By this I mean, broadly, everything that service implies, gives and requires—proper service to the community and a fair return to the utility on a fair valuation. Public ownership of utilities is a long way off, though it may ultimately be the answer. Our municipal governments are too uncertain yet to think seriously of municipal ownership, granting that you must have co-operation between the municipality and its utilities.

Cities all over the United States are spending a great deal of money in laying out a program for everything but utility service. Money is being spent on sewers, water and streets, but how many cities are spending money on future service from their utilities? If your utilities have not a sufficient return to give service, the community suffers. If your transportation utilities cannot automatically expand to meet the transportation of your community, your community suffers.

Financially to-day the utilities are struggling. It isn't a question of war times—their securities started to shrink long before war was mentioned. What is the trouble? What is the answer? Is there co-operation between the municipality and the utility? There seems to be a feeling of antagonism toward public utilities. Is it because the utility is not giving the service that the public demands or thinks it needs? Does the public know what service it does need? Those two questions absolutely demand investigation. As long as this public antagonism exists there is a corresponding shrinking of securities, and naturally there follows a shrinkage in the service rendered by the utility.

Everything points to the necessity of co-operation between the utility and the people.

Having followed this line of thought in Dayton, we went to the transportation utilities and asked: Where are you heading? They do not know. The operating man has not time to think as to the future of his property ten to twenty years hence, but he knows that he is being pinched now. The city employed a man to go over the properties and make a preliminary report as to where they were heading.

You never can get co-operative feeling between the public and the utilities with intermediate franchise. You cannot create an interest in the public mind in any utility if the public has not a direct interest in that utility. I believe that the answer is going to be, and very quickly, an abandonment of these franchises, giving direct to the public a direct benefit, and it will mean a laying out in our communities of a liberal, fair program of expanse to meet the requirements of service.

If your utilities cannot expand automatically, freely, fairly and economically to meet the demands of your community, your community suffers, so, therefore, I believe that it will result in thorough investigations and thorough agreements between municipalities and their utilities, with a determined franchise, with a fair valuation of the property and fair fluctuations in the cost of service to meet the requirements of the time, with a certain return to the city of all over a certain fair return on a fair valuation.

A PLAN FOR HOLDING THE SALES FORCE TOGETHER

How a Sales Manager in Competitive Territory Has Arranged the Work of His Department to Fit the Changed Conditions

A Middle Western lighting company faced with a severe competitive situation has come to the point where it virtually has no electricity in large blocks to sell. To let the sales force go the management feels would be folly, as it is impossible to tell when the competing company will let loose a "drive" for business. Moreover, it is manifestly undesirable to hold a large sales force together merely for the purpose of having the men ready in case such a condition arises.

Previously the new-business department of this company was divided into four groups, residential salesmen, commercial salesmen, power salesmen and special salesmen. It will be observed that these men were all creative salesmen in that it was their business to get as many new customers as possible, regardless of whether they got them from new fields or from the lines of the

competitive company. When the shortage of power arose the company, feeling that something must be done, rearranged its work so that one-third of the force is now engaged in selling appliances, one-third is engaged in holding the present business, and another third is charged with the duty of securing new business.

It is thought that this plan has many advantages. First, it is expected to build up an appliance business on which the company will make a direct profit, since it sells all goods at list price, besides increasing the revenue from existing lines. The third of the sales force employed in holding the company's present business is virtually engaged on defense, and while it really does little that is of creative value, it helps to hold the number of disconnections within a figure close to what the company usually expects from various causes, including customers switched to the other company's lines. Finally, that third of the sales force which is charged with getting new business consists of the best men in the company's department. They go out with instructions to pick the new customers, selecting only those which are the most profitable and whose business will fit best into the valleys of the company's load curve.

This plan, which was originated to build up an appliance business and to hold the company's sales organization intact, has been working for some time, and it appears to be accomplishing its purpose. Later, when it seems advisable to change back to aggressive tactics, the sales manager will have the further advantage of possessing men who are trained appliance salesmen, and even if they should be reassigned to territory with instructions to solicit for all sorts of business, they will have had the advantage of this appliance sales training, and it is less likely that they will forget to mention appliances when closing sales for house-wiring or soliciting other business.

RESIDENCE LIGHTING RATES AND ENERGY CONSUMPTION

Data on a Number of Communities of Varying Size Using Rate Based on Floor Area and Energy Used

BY F. F. ESPENSCHIED

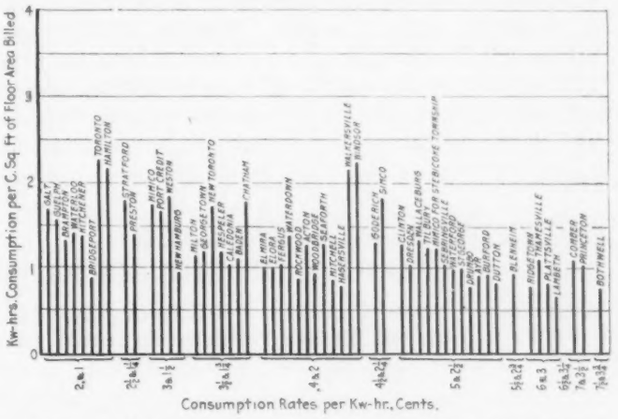
In studying domestic lighting rates and power costs for the purpose of possible readjustments the accompanying charts among others were prepared. Since they refer to a widely scattered group of cities, towns and villages served from the same transmission system, and further since the rates appear quite equitable and satisfactory, the results attained seem worthy of a short explanation.

All the municipalities considered utilize Niagara power, but being situated at various distances from the source of power, the cost delivered varies from town to town. Residence lighting rates are standardized on the following basis:

1. A uniform "service charge" of 3 cents per 100 sq. ft. (9.29 sq. m.) of floor area per month—minimum area 1000 sq. ft. (92.90 sq. m.), maximum area 3000 sq. ft. (278.70 sq. m.). This area is obtained by measuring the outside dimensions of the house, not including porches, and multiplying by the number of living floors; cellars, outbuildings and unfinished attics not being considered. 10 per cent is deducted for walls, etc.

2. A "first consumption rate" of 5 cents or 4 cents or 2 cents per kilowatt-hour, as the case may be, differing from town to town with the cost of power and local conditions. This rate is applied for all energy consumed monthly up to 3 kw.-hr. per 100 sq. ft. of floor area.

3. A "second consumption" rate of 2½ cents or 2 cents or 1 cent per kilowatt-hour, as the case may be, for energy in excess of that used at the first rate. This second rate is taken as half the first rate.

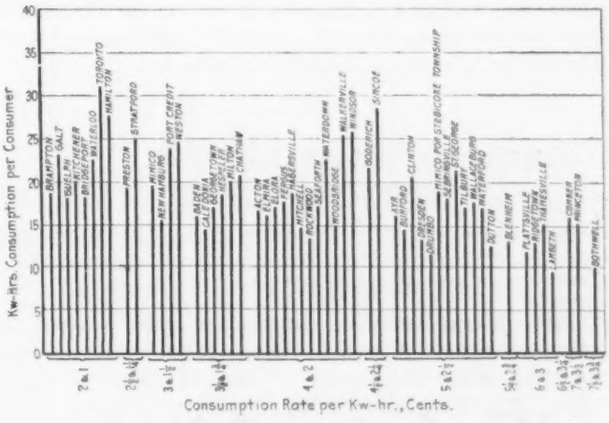


AVERAGE MONTHLY CONSUMPTION PER FLOOR AREA BILLED

4. From the entire monthly bill 10 per cent discount is allowed for prompt payment.

While these rates have worked out well in encouraging the use of electrical devices and stoves, it is found that a very small proportion of residence lighting users consume up to 3 kw.-hr. per month per 100 sq. ft. without a stove. When a stove is installed a part of the energy for cooking comes in at the higher rate, and it is now proposed to change the first consumption rate to apply only to the first 2 kw.-hr. per 100 sq. ft. of floor area. It is also possible that the second consumption rate will be limited to the next 3 kw.-hr. per 100 sq. ft., and that a third consumption rate of approximately half the second rate will apply to all consumption after the first 5 kw.-hr. per 100 sq. ft. per month. When this is done it is anticipated that electric cooking will greatly increase in popularity.

Cost and revenue studies would indicate that with these rates no additional service charge is necessary to take care of stove demands, the diversity being so great that the increased consumption of energy will compensate for the slight extra investment in secondary lines and transformers. The accompanying charts were compiled from customers' records for the months



AVERAGE MONTHLY CONSUMPTION PER CONSUMER

of December, 1915, and June, 1916, averaged and considered as representing an average month in the year. With the exception of a few of the very small villages all municipalities have been operating several years.

In Hamilton, Windsor and Chatham electric light competition exists. Artificial gas is available in Guelph, Waterloo, Stratford and Kitchener, with natural gas in Hamilton, Galt, Chatham, Windsor, Wallaceburg, Simcoe and Walkerville. As a matter of fact, gas competition for residence lighting is not a noticeable factor, but artificial gas in some places, such as Toronto, Guelph and Kitchener, is a competitor for cooking.

INCANDESCENT-LAMP SALE TO FILL UP THE SOCKETS

West Penn Power Company by Offering Standard Package Lots at Reduced Prices Expected to Dispose of 80,000 Lamps in Five Days

The West Penn Power Company during the five days from Dec. 3 to Dec. 7 inclusive conducted its fourth annual incandescent-lamp sale. This sale, which is for the sole purpose of filling up the sockets, can be patronized only by customers. All lamps are sold for cash and none is delivered.

There are two residential sizes in the sale, 25-watt and 50-watt. These are sold only in standard-package sizes, namely five lamps. Both sizes were sold this year for 90 cents per package of five. In the commercial sizes only 75-watt lamps are offered. Gas-filled units are offered for 45 cents apiece, and vacuum units for $1.30 per package of three, or $2.15 per package of five.

Display advertisements announcing the sale appeared for the two preceding weeks in all of the newspapers in the territory in which the company operates. Besides, all customers, residential and commercial, receive a post card in advance of the sale giving a list of the sizes offered and the price.

The first year the company put on this sale approximately 20,000 lamps were sold. Last year resulted in the sale of about 70,000 lamps, while the estimate for this year was 80,000 prior to the sale. As no returns have as yet been received, it is not known how closely the company came to its original estimate.

MORE COMPANIES REFUSE TO FINANCE EXTENSIONS

Binghamton (N. Y.) Property Demands Assurance from Customer that Money Used Cannot Be Better Used to Meet War Requirements

The policy of refusing to finance service extensions and connections is rapidly being taken up by central stations under the stress of present financial conditions. The Binghamton (N. Y.) Light, Heat & Power Company recently made the following announcement of its policy in this connection. It is also stated that this policy is being adopted by all subsidiary companies of the Eastern Power & Light Company and the General Gas & Electric Company:

This company, recognizing that every effort must be made by man, woman and child to win the war, is endeavoring in its operations to conserve coal, labor and supplies. so as to aid in every possible way the authorities at Washington. The recent order of the Fuel Administration in the discontinuing of sign lighting for certain periods in order to save coal at the power plants is a small part of this program and is a forerunner of further economies to be ordered by the authorities.

Beyond these savings, however, there is the urgent necessity of saving capital if we are to give the government the financial support it requires to provide the large sums of money necessary to carry on the war. Extensions to the system of a public utility company, whether in distributing or power plant, require capital which in times such as these should be used only for war purposes. This company has nearing completion a large modern power plant which is effecting a material saving in coal over the present inefficient generating station. This will be completed, as it aids materially the conservation plan and as all arrangements were made prior to the war and the construction is nearing an end.

No further electrical extensions or connections will be made unless the parties to be served advance to the company the cost of such extensions or connections, and then only provided assurance is given satisfactory to the company that the money loaned for the purpose cannot be better used in some other way to meet the nation's war requirements. Where the light or power is required by manufacturers for war contracts, in special cases exceptions to the above rule may be made upon proper evidence from Washington that such contracts are for war necessities.

COST OF ARC LIGHTING IN AN INDIANA CITY

In Town with One Arc Lamp for Each Forty-seven Inhabitants Total Cost Is $46.03 and Operating Cost $17.42 per Lamp per Year

The Crawfordsville (Ind.) Electric Light & Power Company, which is operating 238 arc lamps in its city of 11,300 population, lays claim to having more arc lamps per 100 inhabitants than any other American city. The ratio leads that at Detroit, where, according to the latest records, there is one arc lamp for each forty-nine people. During the year ended July 1, 1917, lamps burning in Crawfordsville on a 4000-hour schedule were operated at a cost of $17.42 each, not including interest and depreciation. The total cost of the arc lighting, with interest figured at 4 per cent and depreciation at 10 per cent, was $46.03 each. The itemized costs were as follows:

Energy	$1,933.60	
Trimming and inspecting	283.76	
Lamp supplies	518.87	
Miscellaneous supplies and expenses	76.64	
Maintenance:		
Material	485.69	
Labor	338.47	
Rectifier bulbs	406.42	
Total operation		$4,043.75
Depreciation at 10 per cent	$4,800.00	
Interest on arc-lighting investment at 4 per cent.	1,928.00	6,728.00
Total		$10,771.45

The energy for operating the lamps, which are of the 4.4-amp., 75-volt Westinghouse magnetite type, amounted to 276,251 kw.-hr. This was charged to the street-lighting system at the cost of energy on the switchboard.

This quota of lamps provides an arc lamp on every corner in the city except in the business district, where incandescent "white way" and incandescent alley lighting is employed. F. H. Miller, manager of the Crawfordsville plant, stated that the outages in the arc-lighting system average only one a night.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

I. E. S. SUGGESTIONS FOR LIGHTING SCHOOL BUILDINGS

Tentative Code of Practice Framed for the Information of Legislative Bodies, School Boards and Others Concerned

GOOD factory and office lighting cannot assure the highest efficiency of future generations if their eyesight is impaired by improper lighting while at school. Recognizing this fact, the Illuminating Engineering Society has prepared a tentative code of lighting for schools for the information of legislative bodies, school boards and others interested in enactments, rules and regulations for better lighting. Extracts from this code follow:

Desirable and minimum illumination intensities[1], based upon present ideas of good practice, are given in Table I.

Glare, either from lamps or from unduly bright reflecting surfaces, produces eye strain; therefore lamps should be suitably shaded and arranged so as to secure

TABLE I—DESIRABLE AND MINIMUM ILLUMINATION

	Artificial Lighting Foot-Candles (Lumens per Square Foot)* at the Work	
	Minimum	Ordinary Practice†
Storage spaces	0.25	0.5- 1.0
Stairways, corridors	0.50	1.0- 2.5
Gymnasiums	1.00	2.0- 5.0
Rough shop work	1.25	2.0- 4.0
Auditoriums, assembly rooms	1.50	2.5- 4.0
Classrooms, study rooms, libraries, laboratories, blackboards	3.00	3.5- 6.0
Fine shop work	3.50	4.0- 8.0
Sewing, drafting rooms	5.00	6.0-12.0

*It should be borne in mind that intensity of illumination is only one of the factors on which good seeing depends.

†Under the column headed "Ordinary Practice," the upper portion of the range of intensities is preferable to the lower; where economy does not prohibit even higher intensities than those cited are often desirable.

good distribution of light on the work, to avoid objectionable shadows and prevent sharp contrasts of intensities. Walls should have a moderate reflection factor, the preferred colors being light gray, light buff, dark cream and light olive green. Ceilings and friezes should have a high reflection factor. The preferred colors are white and light cream. Walls, desk tops and other woodwork should have a dull finish.

The code also emphasizes that basements, stairways, storerooms and other parts of the building, where required, should have switches or light-controlling apparatus at the entrance. Emergency lighting should be provided at main stairways and exits to insure illumination when through accident or other cause the regular lighting is extinguished. All parts of the lighting

[1]The illumination intensity should be measured on the important plane, which may be the desk top, blackboard, etc.

TABLE II—ORDER OF MAGNITUDE OF THE BRIGHTNESS OF SOME LIGHT SOURCES IN COMMON USE

	Brightness (Approximate Millilamberts)
Indirect lighting: Ceiling directly above the lighting unit	5 to 75
Semi-indirect lighting, heavy density glassware	35 to 100
Semi-indirect lighting, light density glassware	200 to 1,000
Direct lighting, 10-in. (25-cm.) opal glass ball containing 100-watt vacuum tungsten lamp at center	500
Direct lighting, vacuum tungsten lamp (frosted) in open-bottom reflector	2,000 to 3,000
Vacuum tungsten lamp, filament exposed to view	500,000
Gas-filled tungsten lamp, filament exposed to view	2,000,000
Gas-mantle, bare	15,000
Gas-mantle, concealed in 6-in. (15-cm.) opal glass globe	1,000
Mercury arc tube (glass)	8,000
Daylight, clear blue sky	1,000

system should be properly maintained to prevent deterioration due to dirt accumulation, burned-out lamps and other causes. To insure proper maintenance frequent inspections should be made at regular intervals.

Direct, semi-indirect and indirect systems of lighting are in successful use in schools, but there has been

TABLE III — APPROXIMATE COEFFICIENTS OF UTILIZATION—MODERN LIGHTING EQUIPMENT*

	Light Color Walls Light Color Ceiling	Medium Color Walls Light Color Ceiling
Small rooms (offices, corridors, etc.):		
Direct lighting, dense glass (open-bottom reflectors)	0.40	0.35
Semi-indirect lighting; dense glass	0.25	0.22
Indirect lighting	0.23	0.20
Medium-sized rooms (classrooms, laboratories, etc.):		
Direct lighting, dense glass (open-bottom reflectors)	0.50	0.45
Semi-indirect lighting, dense glass	0.35	0.30
Indirect lighting	0.30	0.25
Large rooms (auditoriums, etc.):		
Direct lighting, dense glass (open-bottom reflectors)	0.60	0.60
Semi-indirect lighting; dense glass	0.45	0.40
Indirect lighting	0.40	0.38

*The working plane in this case is a horizontal plane 30 in. (76 cm.) above the floor. These values refer to the initial installation without any allowance for depreciation. At the present time, 1917, the lighting output of tungsten-filament electric incandescent lamps, based on average service conditions of regularly maintained installations, ranges from 8 lumens per watt for the smaller vacuum tungsten lamps to 14 lumens per watt for the larger gas-filled tungsten lamps employed in school lighting.

a growing preference for semi-indirect and indirect lighting, especially since the introduction of modern lamps of great brilliancy. Local lighting by lamps placed close to the work is unsatisfactory except for special cases such as the lighting of blackboards, maps, charts, etc. Examples of bad lighting are illustrated.

Except in very rare instances bare light sources should not be exposed to view. They should always be

adequately shaded or completely hidden. Even when shaded by translucent media, such as dense glassware, the lighting units should be placed well out of the ordinary range of vision. In other words, it is recommended that lighting units be of low brightness,[2] even if they are high in the field of view. The maximum brightness contrast of juxtaposed surfaces in normal visual field should be preferably not greater than twenty to one. Glossy surfaces of paper, woodwork, desk tops, walls and blackboards are likely to cause eye-strain because of peculiar or mirrorlike reflection of images of light sources, especially when artificial light is used. Matte or dull-finished surfaces are recommended. The illumination intensity on horizonal working planes should be as uniform as possible. The variation should not be greater than four to one.

The chief factors which must be considered in arriving at the size and number of lamps to be used in a given room are: (1) the floor area; (2) the total luminous flux emitted per lamp, and (3) coefficient of utilization of the particular system considered. The computation for the total lumens required to give a certain illumination intensity in foot-candles can be made with the following formula:

$$(N \times L \times E) \div A = I,$$

where N is the number of lamps, L the lumens output per lamp, E the coefficient of utilization, A the area of floor or horizontal working plane in square feet, and I the illumination intensity in foot-candles.

The placing of blackboards is also considered. Methods of eliminating glare and types of blackboards to be used are brought out. Methods of rehabilitating the lighting of old buildings are described. The code ends with a paragraph in which it is brought out that a systematic maintenance should be provided in order to insure against depreciation in the illuminating intensity due to burned-out lamps, broken gas mantles, discoloration, etc., and to accumulations of dirt upon the lamps and upon the surfaces of the reflecting and transmitting media. It is found in practice that carelessness in this respect may easily reduce the effective illumination by 50 per cent, especially in indirect and semi-indirect lighting.

Generators, Motors and Transformers

How to Overcome the Difficulties of Electrical Repairs.—C. W. STARKER.—The author points out that a large stock of repair parts is a costly investment, and on the other hand deliveries of spare parts are apt to be slow. Looking to the future in planning a motor installation, it is wise to buy only standard types of machines, select only a few ratings and adhere to one type of distribution.—*Industrial Management*, November, 1917.

Lamps and Lighting

Preferred Proportions in Combining General and Localized Lighting.—F. C. CALDWELL and W. M. HOLMES.—A test was made in a small room with a white ceiling and very simple dark-colored furnishing. The general lighting was obtained entirely by reflection. The localized lighting was from a table lamp with opaque reflector and diffusing glass. One hundred observers expressed their preference, and for the conditions described the following conclusions are drawn: (1) With light ceiling and dark walls and throughout a range of foot-candle intensities on the work from two to six, about 40 per cent of localized and 60 per cent of general lighting is preferred; (2) within the above range this ratio is not materially affected by the intensity of illumination upon the working plane; (3) this ratio is approximately the same for men and women; (4) changing the walls to a light color does not greatly affect this ratio; (5) for the above preferred proportions of direct and indirect light and with dark walls the ratio of the brightness of the ceiling to that on the working plane lies between 2½ and 3.—Paper issued by the Illuminating Engineering Society.

Approved Electric Lamps for Miners.—H. H. CLARK and L. C. ILSLEY.—This bulletin describes a number of types of miners' lamps that meet the Bureau of Mines' requirements for safety and performance. The character of tests to which lamps will be subjected before the approval of the bureau is granted is given.—*Bulletin* 131, Bureau of Mines.

Generation, Transmission and Distribution

Comparison of the Working Costs of the Principal Prime Movers.—OSWALD WANS.—The author compares in detail the working costs of the steam engine, gas engine, oil engine and Diesel engine for powers up to 500 brake-hp. and shows for what prices of fuel they are equivalent. The items constituting the total working costs are (1) capital charges, including depreciation, insurance and interest upon capital expenditure, and (2) running charges, including cost of fuel, lubricating oil, water supply, sundry stores, labor and repairs. Rent and taxes are not included. The author includes curves on expenditure, fuel consumption, consumption and load curves and working cost curves.—London *Electrician*, Nov. 9, 1917.

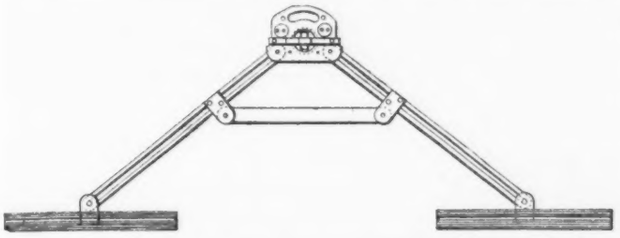
Pressure Increase in the Corona.—EARLE H. WARNER.—Experimental results show that (1) the increase in pressure due to corona appears and disappears much more rapidly than when due simply to heat; (2) the heat in the corona discharge is not a prominent factor until many seconds after the corona appears; (3) in equal energy experiments the increase in pressure due to corona differs from the increase in pressure due to heat by about 50 per cent; (4) at the instant the corona appears the gas in the tube at a small distance from the wire is cooled; (5) the theory advanced by Kunz is verified in one more field, namely in the relation between current and pressure for constant voltage. These results, together with conclusions drawn from simple calculations, force one to believe that the pressure increase in the corona discharge is not due to Joule's heat. With the recent knowledge of the distortion of the field in the corona tube it seems very possible that the increase in pressure is due to ionization.—*Physical Review*, November, 1917.

Installations, Systems and Appliances

Apparatus for the Discovery of Metallic Objects Buried in the Soil.—When one thinks of the formidable mass of iron, steel and metallic alloys that during long months have been showered on the battlegrounds of Europe the question arises of how the earth is to be

[2] Preferably not to exceed 250 millilamberts. A millilambert is equal to the brightness of a perfectly reflecting and diffusing surface illuminated to an intensity of 0.929 foot-candle (0.929 lumen per square foot).

rid of this encumbering metal, which because of the great quantity of unexploded shells and hand grenades that it contains would form an acute danger to agricultural laborers. A systematic "sweeping" of all the bombarded regions will be a necessary preliminary to the resumption of peaceful pursuits therein. So thinking, M. Guillebot de Nerville, engineer in chief of telegraphs and professor at the Ecole des Ponts et Chaussées, draws attention to an interesting apparatus which, though created for this special object, can be applied to other usages, since it will indicate the presence of all metallic bodies not too deeply buried in the soil. This "Alpha" apparatus, as it is called because of its form, will show the presence of a 75-mm. shell at a depth of 40 cm. (about 16 in.) and of a grenade at somewhat less depth. It is based upon the principle of the Hughes induction balance. A vibrated electric current furnished by a Ruhmkorff coil is transmitted to two identical but separated exploring coils, causing respectively an inductive emf. in two secondary coils which are in juxtaposition with them. These secondary coils are connected in opposition in the circuit of two telephone receivers. The two pairs of coils, comprising each a



ELECTRICAL APPARATUS FOR DETECTING BURIED METAL

primary coil and a secondary coil, are theoretically identical. The inductive emf. should therefore maintain a constant equilibrium and the receivers should transmit no sound. This is not usually the case, however, because dissymmetry always exists in the coils, which must be corrected by a regulator. When this has been accomplished, if one approaches a metallic mass with one pair of coils the inductive conditions of these coils will be changed and the telephone will sound. In the Alpha apparatus, of which M. Chanoit was the designer, the four exploring coils are arranged in pairs around two horizontal wooden disks, 60 cm. (about 2 ft.) in diameter, suspended at the ends of two wooden arms fixed at an angle of 45 deg. and joined by a crosspiece. The centers of the disks are about 1.5 m. (4.8 ft.) apart. The regulator is placed at the apex of the two arms. It comprises two small inclosed coils. Of these the exterior coil is fixed and in series with the primary circuit; the interior coil, inserted in the secondary circuit, can be turned 180 deg. in such a way that the angle of the two coils may vary 90 deg. in either direction. This instrument has already been put to use in connection with water service in locating the plates covering taps in places where these have been covered with earth and their exact position is uncertain. Whether the contrivance can be so improved as to be of use in mineral regions or to operate at greater depths remains for the future to show.—*Le Génie Civil*, Nov. 10, 1917.

Pressure Regulation of Rotary Converters.—R. G. DICKMAN.—Two methods of pressure regulation are discussed, (1) by means of reactance and (2) by means of a synchronous booster. The principle of the first method is explained briefly and several curves are given showing values of power factor and reactance under varying conditions. The principle of the synchronous booster is discussed at length, and vector diagrams are given showing its action under different conditions.—London *Electrician*, Nov. 9, 1917.

Wires, Wiring and Conduits

Electrically Controlled Motorboats.—The British Admiralty states that the electrically controlled motorboats used by the Germans on the Belgian coast are twin petrol engine-driven vessels partly closed in, and travel at a high speed. They carry a drum with 30 miles to 50 miles (48.3 km. to 80.5 km.) of insulated single-core cable, through which the boat is controlled electrically. The forepart carries a considerable charge of high explosive, probably from 300 lb. to 500 lb. (136.1 kg. to 226.8 kg.) in weight. The method of operating is to start the engine, after which the crew leave the boat. A seaplane, protected by a strong fighting patrol, then accompanies the vessel at a distance of 3 miles to 5 miles (1.4 km. to 2.3 km.) and signals the shore operator regarding the direction of the vessel. On being steered into a ship the charge is exploded automatically. The device is a very old one. The only new features in the German boats are the petrol engines and W. T. signals.—London *Electrician*, Nov. 16, 1917.

Electrophysics and Magnetism

Anode Resistance Films.—JOHN T. TATE and PAUL D. FOOTE.—Experimental work has confirmed the existence of an anode polarization film, the resistance being less than that of the cathode film. The resistance of the anode film varies inversely with its area, but it should be emphasized that this relation was tested for wires of the same diameter and hence would probably not hold for wires of different diameters.—*Journal of Washington Academy of Sciences*, Dec. 4, 1917.

Efficiency of Production of X-Rays.—PAUL T. WEEKS.—The energy given out in the form of X-rays by a Coolidge tube has been determined by means of a bolometer, the values lying between 20 joules and 125 joules per ampere-second for potentials between 28 kv. and 54 kv. The energy supplied to the X-ray tube has been measured by its heating effect. The ratio between the X-ray energy and the energy supplied to the tube, or the efficiency of production of the X-rays which has been found for these potentials, varies between 0.58 and 1.87×10^{-3}. The X-ray energy is found to be nearly proportional to the cube of the potential across the tube. A comparison of these results with those obtained by others on the total ionization produced by X-rays indicates that only a fraction of the energy of the X-rays is transformed into the energy of the ions produced on total absorption in air.—*Physical Review*, November, 1917.

Telegraphy, Telephony and Signals

Telegraphy and Telephony at the French Front.—It is pointed out that portability is an essential element of signaling stations used at the French front, but the apparatus and methods employed approximate very closely those used in civil service. A central telegraph station, dynamo room and portable telephone switchboard in a station are illustrated and described.—London *Elec. Review*, Nov. 16, 1917.

Scientific and Industrial Research

A Department Devoted to Interchange of Ideas, Investigations Contemplated, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF

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Summary of Investigations, Available Apparatus and Research Suggestions

INVESTIGATIONS UNDER WAY OR COMPLETED (RESEARCH WORK REPORTED SINCE NOV. 17)*

CABLES, HEATING OF.

Experiments are being conducted on heating of paper-insulated cables (some armored) in the ground, in bitumen and in conduits. Valuable results have been obtained showing the relation between the final temperature rise and current density. The values of the thermal resistances of the cable coverings and of the surrounding stoneware troughs filled with bitumen are also being determined.—*National Physical Laboratory and Prof. E. W. Marchant of the University of Liverpool, England.*

COAL.

Classification of coal resources of each district according to their qualities and the seams which are being worked, or which might in certain circumstances be worked, and the industrial uses to which the different kinds of coal are being put. It is intended to conduct investigations into the nature and origin of the various types of coal and into the chemical and physical behavior of their constituents under the action of heat and other agents.—*Fuel Research Board of the Privy Council, London, England.*

GLASS, FOR FIXTURES.

Progress has been made with several systematic investigations on glass problems, and the results of one of them have been published. These relate to the influence of small amounts of chlorides and sulphates in producing opalescence in glass.—*National Physical Laboratory, England.*

MEASURING INSTRUMENTS AND METHODS.

Development of electro dynamometer-type bridge comparator. Development of null method for measuring current, voltage and power; to replace use of electrodynamometer as deflection instrument.—*F. Wenner and E. Weibel, Bureau of Standards, Washington.*

OIL.

Research has been conducted for the last four years into the properties of insulating oils. A number of important engineering laboratories and firms have placed the services of their technical staffs and their works, together with a considerable quantity of oil, at the disposal of the research. A careful collation of existing information was undertaken before laying down the program for work.—*Institution of Electrical Engineers, London, England.*

PEAT.

An inquiry into the methods of preparation and use of peat for fuel and other purposes, and to suggest what means shall be taken to ascertain the conditions under which in the most favorably situated localities it can be profitably prepared and used.—*Committee of Inquiry, Department of Technical Instruction, Dublin, Ireland.*

PORCELAIN.

Extensive laboratory researches into porcelain and refractory materials.—*Dr. Mellor, Central School of Science and Technology, Stoke, England.*

RADIO TRANSMISSION.

Radiation resistance measurement by direct method taking into consideration all losses and field influences.

Form factor of radio antennas, measurement of.

Electromagnetic waves, investigation of the method for finding the direction and distance of origin.

Imperfect conductors and networks in the field of radio antennas, influence of.

Platinum-iridium and telluride vacuum thermo-element to be used for the measurement of very small currents in conjunction with a sensitive galvanometer, study of a new type of.

Thermo-elements for measuring small alternating and oscillatory currents in conjunction with low-resistance galvanometer; development of stable and sensitive types (completed 1917).

Antenna inductance, capacity and resistance, measurement of, with 1 per cent accuracy, taking into consideration the reflection and refraction throughout the system with capacity or inductive loading or parallel loading (completed 1916).

Weather conditions, influence of, on the logarithmic decrement of radio antenna systems and the influence of corona losses (completed 1916).

Antenna ground losses and the influence of geologic formation upon the natural free period of the system (completed 1915).—*Charles S. Ballantine, Director Radio Research Laboratories, Philadelphia, Pa.*

SEA WATER, SALINITY OF.

Development of compensated electrolytic cell for measurement of salinity of sea water.—*E. Weibel and A. L. Thuras, Bureau of Standards, Washington.*

STEAM.

A survey is being prepared of the field of research into the flow of steam in pipes.—*Bradford Association for Engineering Research, England.*

X-RAY BULBS.

Investigations have been conducted for the purpose of removing the difficulties experienced by manufacturers of X-ray bulbs.—*National Physical Laboratory, England.*

SUGGESTIONS FOR RESEARCH

CABLES.

Some tests indicate that a mineral-oil base is vastly superior to a rosin-oil base for impregnating paper insulation of high-tension cables. Considering the dielectric losses, it is claimed by some that mineral oil possesses certain disadvantages in other respects—for example, a greater tendency to drain—although from our experience and observation this is not the case. Some, therefore, recommend a mixture of the two. The dielectric strength of mineral oil varies but little with the temperature, while for rosin oil it decreases rapidly with increasing temperature. Further systematic tests would be of great importance in definitely clearing this point; also tests to determine the exact kind of mineral oil that gives the best results.—*A. S. Bang and H. C. Louis, Consolidated Gas, Electric Light & Power Company, Baltimore, Md.*

CABLES, COOLING.

Among various methods proposed for increasing the current-carrying capacity of underground cables, one is to lay them in special conduits through which water can be circulated or air may be blown. It is desired to work out the mechanical details of such an arrangement and to estimate the benefit derived with the different rates of water or air discharge.

FURNACES.

Electric furnaces for the fixation of atmospheric nitrogen.—*A. I. E. E. Committee on Electrochemistry.*

FUSES, ANNUNCIATOR FOR.

After a fuse has blown on a high-tension branch of a rural transmission line, it sometimes takes several hours before a lineman can be reached. It would be very desirable to provide a simple device which would be set in action by the blowing of the fuse and would report the fact to the nearest station over a special low-tension annunciator wire or over a service telephone line.

FUSES, SELF-RESETTING.

An inexpensive high-tension magazine fuse for branches of rural transmission lines. The fuse should have, say, six wires, of which only one is in service. Should it blow, the next wire should be placed automatically in the circuit. Should two or three fuses blow in rapid succession, indicating a real trouble, an automatic catch should prevent the next wire from sliding into place.

ILLUMINATION.

Automobile headlight glare, its scientific measurement and elimination. Definite standards for state laws and city ordinances.—*Editorial Suggestion.*

LIGHTNING ARRESTERS.

An inexpensive lightning arrester for rural transmission lines at voltages between 22,000 and 60,000. The device must be sensitive enough to relieve promptly over-voltages and at the same time to suppress effectively a power arc should one occur. The arrester may have moving parts, but must not require frequent attention, charging, refilling with a liquid, etc., and must not freeze in the winter.

OIL SWITCHES.

Should high-tension oil switches be rated in terms of the current which they can safely interrupt?—*A. I. E. E. Committee on Protective Devices.*

RELAYS.

Classification and distinct nomenclature of various types of protective relays to prevent their improper use to the impairment of service. Development of relays which permit greater economy in transmission-line metal by enabling lines to be operated in parallel in a number of combinations.—*A. I. E. E. Committee on Protective Devices.*

SWITCHES AND CIRCUIT BREAKERS.

The amount by which their rating should be cut down in cement and flour mills or other dusty atmospheres.—*J. M. Drabelle, Cedar Rapids, Iowa.*

TRANSFORMERS, INSULATING.

On some long rural transmission lines on which troubles have been experienced from static disturbances and electric surges isolating transformers have been used in a few cases with apparently good results. Either a bank of one-to-one ratio transformers is used or else two banks of standard step-down and step-up transformers, so as to avoid ordering special transformers. It is of importance to investigate theoretically and experimentally the actual effect of such transformers and to determine for which particular kinds of disturbances they are effective in localizing the trouble.

TRANSMISSION AND DISTRIBUTION.

A letter of inquiry was addressed to twenty-three members asking for definite suggestions as to the most urgent problems concerning transmission and distribution. Replies containing twenty-four suggestions were received from thirteen individuals. Twelve of these suggestions related to high-tension insulators, seven to underground cables, one to lightning protection, one to relays, one to towers, one to reactors, and one to suppression of transient voltages. It appeared from the result of this inquiry that troubles with high-tension insulators and underground cables were uppermost in the minds of those who replied, most of whom were either operating men or men in close touch with the operation of transmission and distribution systems.—*A. I. E. E. Committee on Transmission and Distribution.*

TRANSMISSION LINE, CAPACITY OF.

On a long rural transmission line carrying a small load considerable trouble has been experienced on account of a disturbing effect of the electrostatic capacity of the line. This capacity sometimes causes poor voltage regulation and also creates favorable conditions for natural oscillations, resonances and surges. It would be well to investigate the possibility of inserting compensating reactive coils at intervals either in series or shunted across the line. These coils must be inexpensive and reliable in service.

VALUATION OF PUBLIC UTILITIES.

Terminology, definition of terms used in appraisals, and a possible unification of views held by various interests and professional groups.—*A. I. E. E. Committee on Economics of the Electric Service.*

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

CALIFORNIA COMMISSION ON WAR-TIME PROBLEMS

John A. Britton, H. F. Jackson and R. H. Ballard Present Their Views at Initial Session in San Francisco This Week

At a hearing on Dec. 10 before the California Railroad Commission, in San Francisco, in its investigation of war-time conditions of electric utilities, John A. Britton, vice-president and general manager Pacific Gas & Electric Company, testified that the available supply of electrical energy in California, without development of water-power sites on government lands, would be exhausted in less than two years despite what can be done through co-operation by interconnection and using power to the greatest advantage. Mr. Britton stated that consumers should share in cost of extensions owing to high price of materials and scarcity of labor, to enable power companies to conserve their own resources for development of efficiency and new power. High price of fuel oil makes necessary the development of more hydroelectric power, but the use of power sites is deterred by federal regulations.

The government can give relief, Mr. Britton stated, by opening power sites on government land. If restrictions were removed, 500,000 hp. would be available in California, 150,000 hp. of which could be developed in two years.

H. F. Jackson, Sierra & San Francisco Power Company, stated that duplication of distributing facilities should be eliminated, thereby saving labor and material. One steam relay plant should be made to serve several companies in the same region, saving fuel oil, wages, upkeep, etc. He believes that the present government policy which is holding back water-power development should be changed quickly. Power companies building large and expensive reservoirs in the mountains benefit irrigation districts below, therefore investment in reservoirs should properly be shared by the power company and the irrigation district.

R. H. Ballard, Southern California Edison Company, spoke of the undesirability of duplication, particularly the paralleling of utility lines by municipalities. The principal handicap of companies is inability to secure capital for development of natural resources. His opinion was that the present financial crisis affecting electric utilities is temporary, due only to the war, and that relief might be obtained by having federal reserve banks discount notes of public utilities.

Mr. Ballard also called attention to the fact that practically every utility in southern California is interconnected and steps are under way to extend that interconnection which benefits consumers and gives added efficiency in operation.

The investigation will continue. The commission will set forth the situation as it finds it and propose the proper remedies. The problems are being worked out with full co-operation and assistance of representatives of all public utilities interested. Jan. 14 has been set for the next hearing, though this date is not definite.

"LIGHTLESS NIGHTS" PLANNED BY FUEL ADMINISTRATION

Proposed to Extinguish All Outdoor Lighting, Except Street Lights and Special Policing Lights on Certain Days

A statement forecasting "lightless nights" was issued by the United States Fuel Administration, Washington, on Dec. 10. It follows:

The United States Fuel Administration has under consideration a definite plan for "lightless nights" throughout the country, somewhat similar to "wheatless" and "meatless" days.

It is now proposed to darken all outdoor lighting, other than street lights and special municipal lights needed for police purposes, on certain nights of each week. On other nights, according to the plan, signs would be permitted to burn.

The plan under discussion provides for radical changes in the order put out on Nov. 9 last, which restricted illuminated signs to certain hours, making such exceptions of merchants' and theater signs as seemed reasonable. In actual application, it appears, this order is impracticable.

The evidence of all eyes is that the streets of cities are virtually as light as before these special signs were darkened. State federal fuel administrations in New York, Illinois and other states have reported in detail on the impossibility of getting results from the old order. They say it is the tens of thousands of small signs that count.

"Lightless nights" would save coal in large quantities, according to the figures before the Fuel Administration. It would be a part of the plan to show every citizen the war necessity and have him join in the saving. In every residence, apartment house and office building people would be asked to use not more than one-half the usual lighting.

Under the conditions noted in the November order the "white ways" have kept their brilliancy and the coal saving has not been large; under the new plan the "white ways" would disappear entirely on certain nights.

ASSOCIATED MANUFACTURERS MEET WAR SERVICE COMMITTEE

Enthusiastic Organization of Industry to Co-operate with the Government Is Furthered by Meeting in New York

Enthusiastic organization of industry to help the government win the war was accelerated by a meeting of members of the Associated Manufacturers of Electrical Supplies held at Delmonico's, New York, on Thursday of this week. It was a conference between members and chairmen of sections of the association and the representatives of the association on the general war service committee of the electrical manufacturing industry. Among those who spoke were H. B. Crouse, Robert K. Sheppard, J. R. McKee and A. W. Berresford.

INDUSTRIAL MOBILIZATION FOR THE PURPOSE OF WAR

Chamber of Commerce of United States, at Meeting in Washington This Week, Brings About Mobilization of Industries

The Chamber of Commerce of the United States at a meeting of committees of business men at Washington on Wednesday of this week brought about the mobilization of industries of the United States for war purposes.

The viewpoint of the government was presented to the meeting by W. S. Gifford, director of the Council of National Defense; Daniel Willard, chairman of the War Industries Board; Harry A. Garfield, Fuel Administrator; Edwin B. Parker of the Priority Board; Clarence M. Woolley, representing the War Trade Board; George N. Peek, industrial representative of the War Industries Board, and others.

Mr. Gifford said that the co-operative committees of the Council of National Defense, which have just been dissolved, had played a most important part in assisting the government to organize the war. It was now advisable to have the industries themselves name committees which should do some of the work which had been done by the council committees, and he intimated that it would not be an easy task to organize industry in this country completely.

Mr. Willard, in discussing the industrial end of the war, said that one mistake made was in concentrating orders too much in certain localities. This brought with it housing problems, transportation problems and in certain instances too great a demand for electric power. He said that at Niagara Falls there has been an overdrain on the supply of electricity available at that point.

Dr. Garfield startled his hearers by proposing the idea that there might be combined action by agreement in each industry with the purpose of reducing the consumption of coal, and said he would be glad to make such an arrangement if the business men present wished to do so. He gave figures to show that coal is being produced and supplied to all industries in larger quantities than in normal times, but that the United States is still 50,000,000 tons short of the unusual demand. These figures led him to suggest willing, co-operative conservation as the only method by which American business can get out of the hole it is in for want of coal.

Edwin B. Parker of the Priority Board, who spoke in place of Judge Lovett, director of priority in transportation, analyzed the objects of the War Industries Board, as he conceives them, one to increase production if necessary, and another to curtail demand if necessary to meet supply. He explained some of the problems of the priority agency in supplying the government as well as private industry, and its successful work through a system of classification, under which certificates allowing shipments are issued in twelve classes. The first, under "A," of which there are six, comprehend the demands of the United States and the allied governments in the way of munitions; those under "B," of which there are also six, comprehend materials for manufacturers, power for manufacturers and transportation requirements for manufacturers.

Clarence M. Woolley, representative of the Department of Commerce on the War Trade Board, urged that business men generally bear in mind the elimination of "profiteering" although not of profit, and paid tribute to the average American business man, who, he said, is doing as much to help to win the war as the boys in the trenches.

George N. Peek, industrial representative of the War Industries Board, spoke of the necessity of co-operation between the industries board and the manufacturers. No industry, he said, will be classified as non-essential, but he said there are, however, many non-essential portions in some industries—odd sizes and styles—and that cutting down these non-essential portions will strengthen industry and prove beneficial to the government and the public at large.

At the Wednesday night session a central war industries committee of the National Chamber was created, of which Waddill Catchings is chairman. The new central committee was empowered by the convention in its resolutions to either increase its number or to organize an advisory council from the chairmen of the various war service committees, or both.

The convention voted that where there are at present war service committees they be requested to ask recognition of the war committee of the National Chamber, and it was provided that if they are organized in conformity with this report they be so recognized. All existing national trade organizations or associations which have not already appointed war service committees are requested to do so immediately. Where there is no national trade association or organization it was recommended that such organization be formed immediately. It was the sense of the convention that war service committees as far as possible shall be representative of the entire industry they represent. All war service committees now existing or selected as provided in the resolutions are to be vested with authority to represent the industries in their relations with the government during the war.

WAR SERVICE COMMITTEE DATA ON CAPACITY AND DEMAND

Electrical Division of War Industries Board Expresses Appreciation of Patriotism in Offers to Invest in Additional Equipment

A bulletin of the electrical division of the War Industries Board dated on Dec. 8 says:

The requirements for motors above 100 h.p., and for power transformers above 500 kva. have increased this past week. Some of the manufacturers have expressed a willingness to expand their capacity in the larger sizes provided we could assure them this additional capacity would be utilized. It would be inadvisable to offer such assurance at this writing. The data brought to Washington by the war service committee for the second conference are being digested and the available capacity tabulated against the existing demands. As soon as this study has been completed, we will know the exact status of production capacity as compared with the demands.

It is our purpose first to satisfy the existing demands and then attempt to estimate future needs. The results of this estimate will be given you for your guidance as to the desirability of increasing your capacity in any type of equipment.

It is a pleasure to express our appreciation of the patriotism displayed in these offers to invest in additional equipment.

CONTRACTORS PROGRESS IN NEW PLAN OF ORGANIZATION

Now Believed to Be Every Probability that New National Executive Committee Will Be Called Together in January

Rapid progress in the acceptance of the new constitutional plan of the National Association of Electrical Contractors and Dealers is reported by James R. Strong. This plan, as outlined in previous issues of the ELECTRICAL WORLD, was prepared by a committee consisting of Mr. Strong as chairman, William L. Goodwin and Earnest McCleary. It was adopted at the annual meeting in New Orleans in October and is now being considered and acted upon separately by the individual state organizations. Mr. Strong said to a representative of the ELECTRICAL WORLD that the plan is receiving enthusiastic acceptance and support. He says that progress is so encouraging that it is likely the new national committee will be called together before the middle of January in Chicago.

The organization meeting of the national executive committee is dependent, however, said Mr. Strong, upon action by the sixth State in the Atlantic division and the second State in the Pacific division.

"Eight or nine States in the Central division have accepted the plan," Mr. Strong said, "and it was expected that a meeting of that division would be held in Chicago this week. In the Atlantic division five States have adopted the plan in the order named: New Jersey, Connecticut, Pennsylvania, Massachusetts and New York. At least four other States are less well organized: Georgia, Virginia, Maryland and also the District of Columbia, which is recognized under the plan as a State. Rhode Island is expected to have a meeting early in the year. It is expected that a meeting of the Atlantic division will be called in New York before Christmas. I am gratified," he went on, "that the lighting companies are taking hold so strongly. The Public Service Electric Company of Newark, N. J., through its merchandising department, has joined the national association as an associate member."

FIGURE COAL SHORTAGE NOW EQUAL TO 130,000,000 TONS

Mr. Manning Shows How Poor Quality Really Increases Deficiency—Good Engineering and Boiler-Room Conservation Needed

In discussing the general need of fuel conservation in boiler rooms, Van H. Manning, director of the Bureau of Mines, issued the following:

There is one phase of the present coal situation which may put an entirely different light on the supposed increased production of coal of the present year. In round numbers, there was produced 600,000,000 tons of fuel last year. Statement has been made that 50,000,000 more tons will be mined this year. The preparation of this increased quantity of coal has not been so good as in times past. Analyses of samples show in many cases a greatly increased quantity of ash. Repeated cases are brought to the attention of the Bureau of Mines where coal which would run from 6 to 8 per cent ash in normal times is running from 12 to 18 per cent of ash in these abnormal times. Complaint about the preparation of coal is very general, and it is not at all improbable that 5 per cent more ash is included in this year's coal than in previous years. If such a figure is true, it means that 32,500,000 tons of the estimated output of 650,000,000 tons is nothing but increased ash. If we can imagine over 600,000 car loads of ash being added to the present burden of transportation, the evident effect on car supply and transportation troubles will be seen.

If this were the end of the matter it would not be so bad, but there is another factor well known to engineers which is apt to be overlooked by the non-technical user. The extensive experiments carried on by the government at the St. Louis exposition showed that with the coals used there was a decrease of about 1½ per cent in efficiency for each 1 per cent addition to the ash content of the coal—that is to say, the inclusion of more ash with the coal not only decreases the value of the fuel the amount equal to the useless ash but it also makes the remaining good coal less effective to the extent of 1½ per cent for each 1 per cent of ash. The inclusion of 5 per cent more ash in the fuel, therefore, means a reduction in efficiency of the remaining good coal of about 7½ per cent, which, added to the 5 per cent useless ash, makes a total reduction in effectiveness of 12½ per cent.

According to this point of view, although 650,000,000 tons may be produced in 1917, its effectiveness as compared with previous years is probably about seven-eighths of this and equivalent to a production of normally prepared coal of about 570,000,000 tons. We have, then, instead of an increased production as compared with last year, an actual decrease of effective coal of about 30,000,000 tons. If this be added to the estimated increased needs, due to our accelerated activities, of 100,000,000 tons, we have a deficiency of the equivalent of 130,000,000 tons, instead of 50,000,000 tons, to make up by good engineering and true fuel conservation in the boiler room.

ENGINEERING STUDENTS IN MILITARY SERVICE

New Ruling by Provost Marshal General Places Selected Students in Enlisted Reserve Corps of Engineer Department

A new ruling of the Provost Marshal General, modifying in material degree the position held heretofore in regard to the exemption of engineering students in the draft, was issued at Washington on Dec. 8.

The following has, therefore, been added by the Provost Marshal General to Section 151 of the selective service regulations:

"Under such regulations as the chief of engineers may prescribe a proportion of the students pursuing an engineering course in one of the approved technical engineering schools listed in the War Department as named by the school faculty may enlist in the Enlisted Reserve Corps of the Engineer Department upon presentation by the registrant to his local board of a certificate of enlistment. Such certificate shall be filed with the questionnaire, and the registrant shall be placed in Class V on the ground that he is in the military service of the United States."

The regulations of the chief of engineers limit this privilege to those students to whom the school issues the following certificate properly attested by the president of the school:

"I hereby certify that ——— is a regular student of the ——— class in good standing as candidate for an engineering degree at ———, and that in the judgment of the faculty of this school, based upon his academic record supplemented by his relations with fellow-students and by observation of his instructors, he may fairly be regarded as deserving a place in the first third qualitatively of the young men graduating from this institution during the past ten years."

Service Quickly Restored at Halifax

After-Results of Terrible Explosion's Disaster and Loss of Life Are Lessened by Rapid Restoration of Public Utility Service—Great Devotion Shown by Officers and Employees—Many Offers of Help

FOUR thousand tons of trinitrotoluol (T. N. T.) exploded on board the French munitions ship Mont Blanc at Halifax, Nova Scotia, on Thursday morning of last week, killing about 1200 persons, injuring many thousands and destroying about five square miles (1295 hectares) of the city and suburbs on the north side of the provincial capital. The explosion followed a collision in the "narrows" of Halifax harbor between the Mont Blanc and the Belgian relief ship Imo, and led immediately to conflagration which transformed the afflicted area into ruins within a few hours. About 25,000 people were rendered homeless, scarcely a building in Halifax or Dartmouth escaped injury, and the property loss is estimated at $20,000,000. Despite the terrible and widespread devastation, public utilities in the main escaped crippling losses. A representative of the ELECTRICAL WORLD who went to Halifax reports that in the period of rescue and revival these utilities are rendering service of untold value.

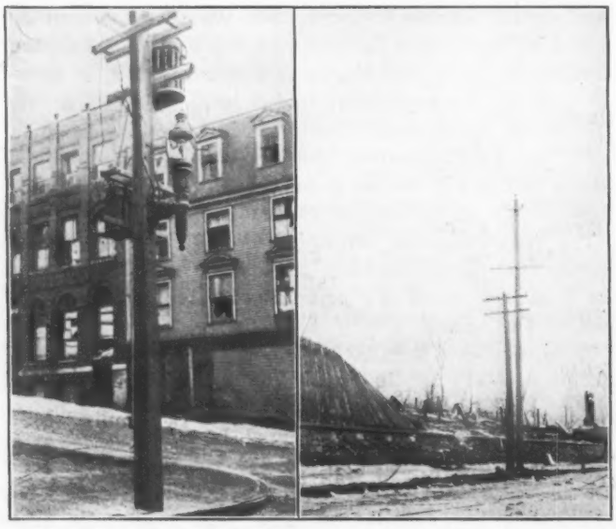
Electric lighting and power service in the Halifax district is supplied by the Nova Scotia Tramways & Power Company, Ltd., which also operates the electric railway and manufactures and sells gas in Halifax. It serves a population of about 65,000. The Canadian government has undertaken extensive dock improvements at Halifax to cost about $30,000,000, of which about $10,000,000 has already been expended or contracted for. Annual gross earnings of the Tramways & Power Company are about $800,000. The company owns important water-power rights on the Gaspereau River, 55 miles (88.5 km.) from Halifax, capable of a hydroelectric development of about 12,000 hp.

A general description of the central station system was published in the ELECTRICAL WORLD Nov. 23, 1912, page 1089. The generating plant is on the west side of Halifax harbor, about one-half mile (0.8 km.) from the business center and approximately 2.5 miles (4 km.) south of the explosion center. Its generating ca-

NOVA SCOTIA TECHNICAL INSTITUTE

Although this building is situated two miles south of the explosion center, nearly every window on the north side of the structure was blown in by the force of the concussion.

DEVASTATION OF WATERFRONT, HALIFAX HARBOR, NORTH OF THE NORTH STREET RAILROAD STATION



ONE OF HUNDREDS OF SHATTERED ARC-LAMP GLOBES; WRECK OF 13,200-VOLT TROLLEY LINE

TELEPHONE AND SUPPLY LINE WRECKAGE; TROLLEY CAR WARPED OUT OF SHAPE; EMERGENCY LINES AT RIGHT

pacity is 5700 kw. There are now two horizontal turbo-alternators supplied by the Canadian General Electric Company and two 600-kw. units directly connected to Rice & Sargent engines. The turbines are rated at 1500 kw. and 3000 kw., the latter machine having been added recently. The boiler plant consists of seven 350-hp. and seven 300-hp. Babcock & Wilcox units, the former being equipped with Jones underfeed stokers and the latter with B. & W. chain-grate stokers. There are two Alphons-Custodis stacks, one 90 ft. (27 m.) high and 7 ft. (2.1 m.) inside diameter, the other 175 ft. (53.3 m.) high, with an inside diameter of 8 ft. (2.4 m.).

Quite recently the company has added materially to its power load, and its residential and commercial lighting business is an important factor in its service. Window lighting, however, is restricted in Halifax by war regulations requiring the shielding of interior illumination from egress through windows and doors. It is estimated that if this restriction were not enforced about 500 kw. in additional lighting load would be thrown upon the station. H. R. Mallison is managing director of the Tramway & Power Company, Philip A. Freeman being superintendent and chief engineer.

Telephone service in the Halifax district is furnished by the Maritime Telephone & Telegraph Company, J. H. Winfield being general manager. Telegraph facilities are handled by the Canadian Pacific Railway, Fred L. Colborne being in charge of the local office, and by the Western Union Telegraph Company, G. L. Laidlaw local manager. Halifax is also an important cable center.

EFFECTS OF THE EXPLOSION AND FIRE

The explosion occurred at 9.05 a. m. and destroyed the greater part of the overhead lines in the so-called Richmond district of Halifax, as well as in Dartmouth. Breaks and short circuits in the distribution system of the Tramways & Power Company necessitated shutting down the generating plant for a short period, but within an hour the station was again supplying energy through parts of its territory outside the explosion zone. The fall of the overhead circuits, trolley wire and feeders opened a large number of automatic breakers and switches at the power plant. Practically all windows and doors on the north side of the station were blown in, débris scattering about the operating room for 40 ft. to 50 ft. (12 m. to 15 m.) from the wall. The tremendous air currents set in motion knocked down some employees. None in the station, however, was injured seriously. Windows on the north side of the station were of wired glass set in steel sashes, but these were blown to bits. A large amount of glass was blown into the motor-generators near the north wall, and the railway switchboard was also subjected to a shower of this material. Little damage was done, however, either in the station or in the adjacent car repair shop. The boiler room suffered little if at all. Considerable damage was done to the gas holder, which was stripped of some crown plates. About 200,000 cu ft. (17,000 cu. m.) of gas escaped. The holder was repaired and gas put in on Sunday morning at 11 o'clock. The company is not yet aware of the damage which mains may have sustained in the zone of the explosion and fire. Minor cracks developed in the gas retorts.

Many of the short circuits on the distribution system were burned out quickly. As soon as possible the line superintendent and two men proceeded to the vicinity of the North Street station (the Halifax railroad passenger terminal) and cut clear across the city, beginning at North Street, all the overhead lines of the company entering the devastated district. This work was completed during the afternoon.

Restoration of general service to residences and commercial establishments within a few hours of the explosion was greatly appreciated by citizens and customers. Many power customers had business places damaged by explosion or destroyed in the fire. Prior to the disaster the peak load upon the station was 3100 kw., but curtailment of demand resulting from destruction of so large an area has reduced this to about 1500 kw.

Street-lighting service was not generally interrupted outside the explosion zone. Some rearrangement of circuits was required at the station tub transformers, but this was done in time to light streets over a large part of the city when night fell. A considerable number of arc lamps were injured by the air blast, many globes being broken. A shortage of lamp trimmers resulted from the natural disorganization because employees went into the danger zone to ascertain the condition of families and homes. No public utility linemen were killed in the explosion or fire so far as has been learned, and great devotion has been shown by officers and subordinate employees of all the companies in striving to get things back toward normal in all branches of service.

The tramway company supplies energy to Dartmouth over a 13,200-volt transmission line, which passed through the explosion zone. This line was wrecked at one point not far from the North Street terminal. It crossed the harbor as a submarine cable and as yet it is not known whether the cable was injured.

For an hour after the explosion operators continued giving service, but were obliged to leave their posts upon demand of the military authorities. Meanwhile fire was raging in the stricken district and caused further serious damage to both telephone and telegraph lines. Telephone service in the downtown and southwestern parts of Halifax was resumed rapidly, and by mid-afternoon conditions approached normal outside the explosion area. Many operators remained loyally at work in spite of having relatives killed or injured. During the afternoon a government telegraph line was placed in service. Two telephone company operators are among the missing.

A great degree of credit is due to public utility employees and officers whose unselfish efforts accomplished so much in the face of great obstacles. Telegraph operators and company staffs outside Halifax, no less than within the city, worked without stint day and night to restore lines and to handle the traffic.

Public utility companies, manufacturers and engineers in many parts of Canada and the United States have vied with each other in relief work, sending personal representatives and offers of aid to a degree greatly appreciated in Halifax.

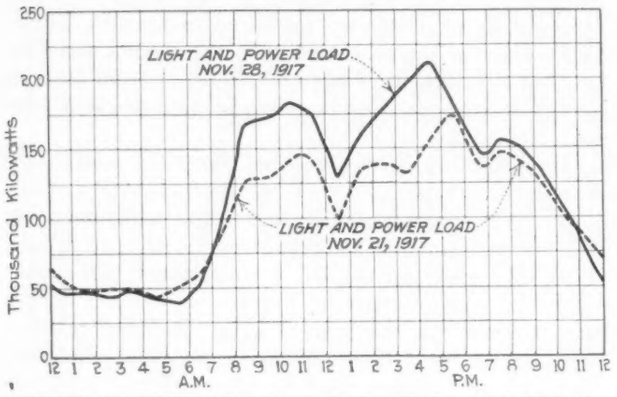
It seems probable now that financial losses to public utilities will not exceed $150,000 to $200,000, although details are scarce. The tramway company loss appears to be under $100,000 at this writing.

HOW DAYLIGHT DARKNESS AFFECTS THE LOAD CURVE

Condition of Atmosphere Makes Difference of 35,000 Kw. in Light and Power Load of Commonwealth Edison Company of Chicago

The entire city of Chicago was blanketed by a dense black cloud of fog and smoke on Nov. 28. In the downtown or loop district especially darkness equal to night was closely approximated.

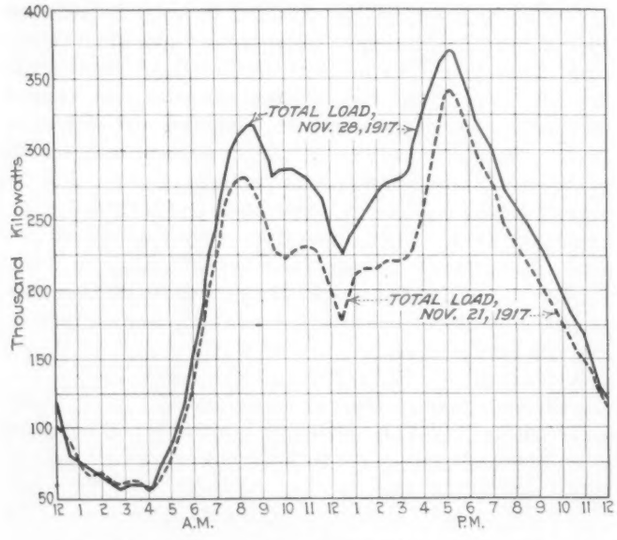
The effect of "daylight darkness" on the load thrown


LIGHT AND POWER LOAD NOV. 28, 1917
LIGHT AND POWER LOAD NOV. 21, 1917
Thousand Kilowatts
250
200
150
100
50
0
12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
A.M.
P.M.

LIGHT AND POWER LOAD ON A DARK AND ON A LIGHT DAY

on the Commonwealth Edison Company lines is best shown in accompanying curves.

Fig. 1 shows the light and power load on Nov. 28—the dark day—and on Nov. 21, a fairly clear day one week previous. In both forenoon and afternoon peaks the load was about 35,000 kw. greater on the dark day. If imagination is given free rein, the curves may be interpreted to show also that some people did not arise so early on the dark day as was their custom. The small dip in the curve between 6 p. m. and 7 p. m.



TOTAL LOAD ON A DARK AND ON A LIGHT DAY

might be attributed by some to effectual working of the Fuel Administrator's sign order. The truth is, however, that it is caused by the going-home habit, and represents the period between which light is used at the office and at the home. The sign business is too small to show any effect.

Fig. 2 shows the total load on Nov. 21 and Nov. 28. These curves include light and power load in addition to railway load. It is interesting to compare the curves with a similar set on another dark day in 1913. Those curves were published in the ELECTRICAL WORLD on Dec. 13, 1913, page 1199.

SMALL-TURBINE SITUATION AND WATER-COOLING DATA

Abstracts of a Few Important Papers and Discussions Presented Before the Recent Annual A. S. M. E. Meeting in New York

Several valuable papers and discussions were presented at the recent annual meeting of the A. S. M. E. which could not be abstracted in last week's issue of the ELECTRICAL WORLD for lack of space. They were on the subjects of "A Commercial Analysis of the Small-Turbine Situation," "The Cooling of Water for Power-Plant Purposes" and "The Transfer of Heat Between a Flowing Gas and a Containing Flue," being prepared by W. J. A. London, C. C. Thomas and Lawford H. Fry respectively.

COMMERCIAL ANALYSIS OF SMALL-TURBINE SITUATION

Mr. London's paper was devoted to a commercial analysis of the four types of small steam turbines now on the market and used for the driving of auxiliary machinery. The paper deals principally with non-condensing units. In these high thermal efficiency is in many cases unnecessary on account of economic utilization of the exhaust steam, and as economy bears a definite relation to first cost, a highly efficient machine is often a mistaken investment. Moreover, operating conditions are generally such that the designer must sacrifice considerations of efficiency if they interfere in any measure with simplicity and durability.

The theoretical design, according to the author, presents no difficulties, but the mechanical design is what determines success or absolute failure. Some of the problems involved and the methods that have been employed in solving them successfully are indicated.

The average specification calls for very rigid guarantees as to steam consumption, speed regulation and load requirements. These, in the opinion of the author, are in most cases unnecessarily severe and merely tend to increase the cost of installation. After an extended survey of the situation, he has formulated a "code of practice," given in an appendix to the paper. The adoption of this code would, he believes, bring about a reduction in selling prices, eliminate many of the unpleasant experiences which now often arise between manufacturers and customers, and thereby increase the popularity of the turbine-driven unit.

Among those presenting discussions on this paper were O. D. H. Bentley, C. P. Crissey, M. Nusim, Prof. A. G. Christie, A. L. McMurtry and Herbert D. Reynolds.

Mr. Bentley pointed out that the water rate rather than the horsepower determines the diameter of a turbine rotor and questioned the advantage of the extra capacity of Curtis turbines for a given diameter. Although overhung turbines are cheaper, most engineers favor rotors hung between bearings. Self-contained apparatus has the advantage that the responsibility for improper operation cannot be shifted

Owing to the difficulties in providing proper clearances with overhung units, Mr. Crissey stated that overhung units should be developed only by manufacturers of combined units and not by manufacturers of separate units which are later combined.

Mr. Nusim pointed out that the steam economies possible with some of the small units now on the market are as high as those formerly obtained with much larger units. On account of war conditions, water treatment and use of economizers are more necessary than ever, Professor Christie contended. Since less exhaust steam is required for feed-water heating when economizers are used, the efficiency of auxiliary turbines should be higher than would otherwise be necessary. Attention was called to the necessity of knowing the effect of various back pressures on the performance of turbines and of determining whether maximum efficiency should be obtained at normal rating or less.

Mr. McMurtry urged simplicity, reliability and efficiency in auxiliary turbines. To this end the company with which he is connected is arranging for forced oil circulation in all turbines except small ones using ball bearings. Oil coolers are advisable, and governors should receive ample lubrication. Machines should be designed so that flexible shafts are not required. Emphasis was laid on the importance of purchasers specifying the conditions under which turbines should carry rated load.

Mr. Reynolds points out that turbine efficiency is important where exhaust is used for feed-water heating, since, while all heat is recovered, utilization of the exhaust steam does not make up for the boiler losses in producing the steam. Where the exhaust is used for industrial heating, etc., the efficiency is not so important.

In closing, Mr. London pointed out that considerable trouble is due to turbines getting out of alignment. Under present conditions more serious thought should be given to the question of whether to pay more for a turbine to obtain higher efficiency, as operating costs are becoming considerably larger relative to fixed charges. In replying to Mr. McMurtry's contentions, he expressed the opinion that forced feed is not necessary for small turbines as oil rings are sufficient. Overhung turbines should not be objected to on the basis that the critical speed is reduced, as the latter is a direct function of deflection. Since this is reduced when an overhung rotor is used, the critical speed is raised.

Cooling of Water for Power Plant Purposes

The paper by C. C. Thomas gave the results of an extended experimental investigation into the conditions governing the cooling of condensing water of power plants by means of spray ponds. This investigation involved determining the efficiency of the cooling process under varying conditions of pressure at the spray nozzles, the temperature of the water to be cooled, the power required to circulate the water, the height of sprays above the pond surface, the effect of wind velocity on the cooling range, etc. The work has resulted in a large collection of data, much of which was included in the paper.

As a result of his experiments the author has developed a new form of spray head or nozzle which is so adjustable that the film of water discharged may be broken into a uniformly fine spray, a mist or a large number of small drops, as desired. This method of spraying is particularly applicable to low-pressure work, a pressure of 10 in. (25.4 cm.) of mercury giving an exceedingly fine spray, and 8 in. (20.8 cm.) usually sufficing. The newly developed spray head provides for the control of the system in a manner which, while somewhat less complete than in the case of the cooling tower, yields results comparing very favorably with those for the tower and can be installed and operated at a much lower cost.

Among those who discussed the paper were B. R. T. Collins and Prof. A. G. Christie. Mr. Collins pointed out that it is advisable to have a certain depth of water in a cooling pond, as the bottom of the pond will otherwise absorb heat and transmit it to the water, thus cutting down the cooling effect. He also said that the lowest efficiency is obtained in cool, dry weather, whereas the highest efficiency is obtained in hot, humid weather. This is just the opposite of experience with cooling towers.

Professor Christie said that it had been found that 18 in. to 20 in. (45.7 cm. to 50.8 cm.) of water is better than 3 ft. (91.4 cm.) of water in a spray-cooling pond.

Transfer of Heat Between a Flowing Gas and a Containing Flue

In his paper on this subject, Lawford H. Fry of Burnham, Pa., showed that, in the range of experimental data available, a logarithmic formula adapted from that proposed by Hedrick and Fessenden gives satisfactory results. In passing x ft. along a flue of mean temperature t the change in gas temperature from T_1 to T_2 is given by the equation

$$\text{lolog } T_1/t - \text{lolog } T_2/t = Mx,$$

where "lolog" means the "the logarithm of the logarithm" and the coefficient M is determined by the perimeter and hydraulic depth of the flue and by the rate at which the gas flows. Simple formulas connecting the coefficient M with these quantities are given.

The wide range of the experimental data on which the formula is based may be summarized briefly as follows:

Gases.—The gases experimented with were products of combustion, lighting gas, CO_2 and air, all at atmospheric pressure; also air at pressures ranging from 0.15 lb. to 140 lb. per square inch (1.05 kg. to 7.8 kg. per sq. cm.) absolute.

Rate of Flow of Gas.—The rates of flow ranged from 0.5 lb. to 650 lb. (0.23 kg. to 294.8 kg.) per hour.

Flues.—Flues of annular and circular cross-section were used, with effective diameters ranging from 0.5 in. to 2.0 in. (1.27 cm. to 5.08 cm.), and of lengths from 0.64 ft. to 20 ft. (0.18 m. to 6.1 m.).

Temperatures.—The inlet temperatures ranged from 2340 deg. Fahr. (1280 deg. C.) with the products of combustion being cooled to 55 deg. Fahr. (12.8 deg. C.) with air being warmed.

The paper was discussed by Prof. E. A. Fessenden, G. L. Ostrand and D. S. Jacobus.

W. J. Baldwin of New York City presented a paper on "Apparatus for Cooling, Drying and Purifying Air."

"Plotting Boiler-Test Curves" was the subject of a paper by A. H. Anderson of Chicago, Ill. A method is presented by the author, the utility of which is demonstrated by the solution of problems from graphically recorded test data.

UTILITIES TO HELP SELL THE WAR SAVINGS STAMPS

Frank A. Vanderlip Says Companies Can Establish in Their Offices Authorized Selling Agencies—John W. Lieb Urges Co-operation

Frank A. Vanderlip, as chairman of the National War Savings Committee, asks utility companies to help the sale of the $2,000,000,000 of war savings stamps.

John W. Lieb, chairman of the National Committee on Gas and Electric Service and president of the National Electric Light Association, to whom Mr. Vanderlip has written about the matter, has formally called the attention of the N. E. L. A. to the plan and urges active co-operation to assist the government.

The letter from Mr. Vanderlip to Mr. Lieb says in part:

These stamps will be obtainable at post offices, banks and trust companies, but to make the campaign an unqualified success it is the government's desire to have them for sale at as many other authorized agencies as possible.

The public utility companies offer admirable facilities for assisting in this campaign through their offices, which are equipped to handle cash and are constantly coming in contact with the general public.

While the committee will send communications to all utility companies asking their assistance by establishing in their main and branch offices authorized selling agencies of the United States Treasury, it has felt that your association can be of great help by indorsing this movement and urgently soliciting the hearty co-operation of its members.

Inclosed is a pamphlet giving full details concerning the war savings stamps together with a circular suggesting steps to be taken by utility companies in establishing in their offices authorized selling agencies of the United States Treasury. Companies can buy original supply of thrift stamps and war savings stamps at nearest post office as per second method in attached circular and replenish their offices according to day-to-day sales capacity.

The government invites your co-operation and assistance in this very important undertaking. The urgency of your giving all co-operation possible cannot be too strongly emphasized. If we are to win the war, we must win it as a united people. The thrift and savings of every man, woman and child are necessary to insure American honor and the cause of democracy throughout the world.

The formal letter sent to the N. E. L. A. by Mr. Lieb as chairman of the National Committee says:

The National Committee on Gas and Electric Service, representing various public utility industries in war service matters, has rendered effective service to the Treasury Department through the member companies of the national associations of the respective industries in connection with the promotion of the Liberty Loans. The committee has now been called upon for further service and has promised the hearty support and co-operation of all of the public utility companies represented in its activities in connection with the placing with the public of thrift and war savings stamps, soon to be issued by the United States Treasury Department under the auspices of the National War Savings Committee, Frank A. Vanderlip chairman.

You will receive at an early date a letter from Mr. Vanderlip containing a direct appeal to your association, inviting its co-operation through the utility companies which it represents throughout the country in assisting the placing of the war savings certificates with the people by placing them on public sale in all of the cash-handling offices and branch offices of the utility companies, which for this purpose will be made authorized selling agents of the United States Treasury.

On receipt of the communication from the National War Savings Committee, will you kindly communicate at once with each member company represented by your association, urging its active co-operation in assisting the government in giving the widest possible publicity to the plan of war savings, and making available, as far as practicable, as sub-agencies of the government for the sale of these stamps, every public utility office in the land?

It is expected that the National War Savings Committee will communicate directly from its Washington headquarters with every utility company in the United States, whether connected with a national association or not, but it is urged that you may be of assistance by indorsing the movement and inviting in a separate communication to each one of your member companies its hearty co-operation and support of the movement.

SELL WAR SAVINGS STAMPS

Mr. Vanderlip says in his letter to Mr. Lieb:

"In brief, the war-savings plan offers a means whereby any individual may assist in winning the war by investing his savings in amounts of 25 cents in government thrift stamps. When sixteen thrift stamps have been acquired they may be exchanged for a five-dollar war savings stamp, by adding 12 cents in cash prior to Feb. 1, 1918, and 1 cent additional each month thereafter. Those who prefer may buy five-dollar war savings stamps outright. Both kinds of stamps will be purchasable from December, 1917, to Dec. 31, 1918, and the war savings stamps will be redeemable on Jan. 1, 1923, at purchase price plus accrued interest at 4 per cent per annum, compounded quarterly. Thrift stamps will bear no interest."

"SURELY CONGRESS WILL RELEASE THESE RESOURCES"

Secretary of the Interior Lane Draws Attention to the Need of Congressional Action on Water Powers

Secretary of the Interior Franklin K. Lane, in a brief practical discussion of the war, says in his annual report to Congress, made public this week:

Modern industrialism may be epitomized as power plus iron. We lack neither. It is the unprecedented and the not-to-be-anticipated burden of providing not alone for ourselves, but for nearly all of western Europe and part of Asia and Russia which makes the great demand. For our own needs we have coal and iron and nearly all the rich line of less common minerals in abundance. It sounds most boastful to say that the most paternal of governments, intent upon a dynastic purpose, would hardly have found ways to supply itself more liberally with the fundamentals of the great war industries than has been effected by the quiet searching and working of this free people. And what is true as to minerals is equally true as to the products of the soil. The large liberty of life and the casting of responsibility upon the individual, allowing personal ambition to be a substitute for direct command, and curiosity to be the spur to knowledge—these have put under crop the greater part of the continent and made this the relief depot of starving nations.

Of one thing, however, we may be sure, that a nation intent upon its own self-sufficiency would not be holding under what is tantamount to government withdrawal the two newest sources of power—substitutes for that coal which costs the labor of a million men and is the greatest of all the burdens of our railroads—water power and petroleum. It may be expected surely that Congress in its coming session will release these resources by passing those leasing bills which have so long been pending in both houses.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Minimum Charge Advanced. — The Cloverport (Ky.) Light & Ice Company has advanced the minimum charge for lighting service from 50 cents to $1 monthly.

Detroit Edison Stockholders Authorize Debentures.—Stockholders of the Detroit Edison Company have authorized the issue of $9,000,000 convertible debenture bonds. The interest rate will be determined by the directors.

Water Shortage Affects Tacoma Plant.—The long-threatened water famine in the Nisqually River has materialized, and the Tacoma municipal light plant at La Grande has been incapacitated so badly that Commissioner of Light H. F. Gronen has been compelled to cut off the Nitrogen Products Company load of 3000 kw., the Bilrow Alloy Company load of 3000 kw. and the Tacoma Railway & Power Company emergency load of 3000 kw.

Malicious Breakage Costs City $30,000 a Year.—The Department of Gas and Electricity, city of Chicago, announces that each year it is forced to spend approximately $30,000 to repair malicious damages to street-lighting equipment. Work now in progress will within a year double the number of street lamps in operation, and this will probably increase the damage to $60,000. It is estimated that $60,000 would pay for operation of approximately 8000 new-style tungsten lamps, now being installed, or 2000 600-cp. lamps. The department of gas and electricity is endeavoring to institute a vigorous campaign against this wanton waste and hopes soon to be able to make an example of some of those who commit the depredations in question.

Municipal Plants at Hamilton, Ohio, Losing.—In the report of Engineers Maed and Seastone the valuation placed on the municipal gas, water and electric plants at Hamilton, Ohio, is $1,672,250. Each is said to be in an unsatisfactory physical condition. In 1916 the electric plant is said to have showed a profit of $22,359, but the water plant lost $11,687 and the gas plant $32,344. The loss for the last seven years is placed at $300,000. Causes for this condition are the lack of co-operative action between the executive and legislative departments of the city government, resulting in insufficient appropriations for extensions; non-observance of state laws and city ordinances, bad administrative policies, and appointments apparently made on a political basis rather than for ability and efficiency. The report advises increase of rates in all departments and improvement of plants according to modern methods. It criticises municipal ownership and says that its history is not one of which the country can be proud. A municipality cannot, as a general proposition, it holds, generate power or furnish service at a cost to itself as low as a private company can. Messrs. Maed and Seastone were employed by the city to make an investigation of the plants at a cost of about $3,000.

Giving Telephone Service in Washington.—D. S. Porter, manager Chesapeake & Potomac Telephone Company at Washington, has made public interesting figures in regard to growth of wartime telephone service. There are now more than 7000 government telephone stations in Washington and its environs. On Jan. 1, 1917, Washington had a telephone plant for 350,000 people, the population. Needs of the company had been prearranged for a year, including a 30 per cent increase on account of the inauguration period in March, but there was a 55 per cent increase about April 6, when war was declared. The total increase has now become 70 per cent for Washington calls and 219 per cent for long-distance calls. More than 400 expert workmen from other communities have been employed in Washington in installation work since the middle of March. Five training schools for operators were established. One difficulty is that the company has surrendered to the government many trained operators needed for most important government stations. Government telephone stations in Washington alone increased 75 per cent during the period. Switchboard manufacturers all over the country turned their complete output over to Washington.

Increases in Rates. — Joseph H. Brewer, president American Public Utilities Company, says in a report to stockholders: "In addition to the increases in rates reported to you on Oct. 1, the company has been successful by negotiation with the citizens in obtaining increases in its rates at Jackson, Miss., where we are operating under franchises. At Holland, Mich., where the rate for gas is 90 cents per 1000 cu. ft. and where the company has for a number of years been operating at a loss, notice has been given to the city authorities that the company is unable to meet its present operating expenses from the revenues derived from the sale of gas and therefore, regardless of the provisions of the franchise, it will be necessary to collect $1.15 per 1000 cu. ft. or cease operating the plant. The city authorities have indicated a disposition to contest the proposed action of the company in raising its rates and this will undoubtedly lead to litigation and possibly a receivership for the Holland City Gas Company. All of the stock and substantially all of the bonds of the company are owned by the American Public Utilities Company. It has been the judgment of the officers of the company that this result is preferable to suffering further loss over the period of the franchise. Every kilowatt-hour which it is possible to generate at the new Wissota dam is being sold."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Rules Regarding Meter Deposits.—The general rule is that a public service company furnishing gas may require the charges to be paid for a reasonable term in advance or be secured by a reasonable deposit by the consumer, and may enforce such a requirement by the refusal of service to persons who do not comply, the Court of Appeals of Kentucky held (197 S. W. 1081). The rule permitting the utility to require a deposit does not permit the company to hold the consumer's money without paying interest.

Water Appropriations Aid Abandonment.—Under the code, where the first appropriator within reasonable time commenced to apply all the water claim to the use stated, he could ignore intervening and subsequent appropriations, the Supreme Court of Washington held in Pleasant Valley Irrigation & Power Company versus Okanogan Power & Irrigation Company (167 P. 1122). The mere fact that a flume carrying waters from several streams was the same size above and below the point of diversion from one stream did not show an abandonment of the right to take waters from such stream at some future time.

Damages Where Insurance Is Available.—In an action against an electric company for damages for the death of plaintiff's husband, a lineman in the employ of a telephone company, killed by coming in contact with the electric company's defectively insulated wire strung on the same pole and close to the telephone company's line, the plaintiff's release of her rights against the telephone company on the receipt of certain insurance money from an insurance fund payable independently of negligence, did not preclude her action of tort against the electric company, although the release in terms covered any claim which plaintiff might have against the telephone company, the Supreme Court of Pennsylvania held in Ridgeway versus Sayre Electric Company (102 A. 123). In an action for personal injury the defendant cannot show, either as a bar to the action or in reduction of the damages, that the injured person received, or was entitled to receive, compensation for his injury in form of insurance or otherwise. An electric company whose wires by agreement were strung on the same pole as those of a telephone company and carried a heavy current was bound to see that its wires were in such reasonably safe condition as to afford protection from injury to employees of the telephone company coming in contact with them in the course of performing the duties of their employment.

Louisiana Engineering Society.—A meeting of this society was held Dec. 10, First Lieut. Joseph F. Ward, O. R. C., telling of his experience in training camp.

Jovian Electrical League, Los Angeles.—Judge Benjamin F. Bledsoe of the United States District Court addressed the league at its meeting on Dec. 5 on "Americanism."

Buffalo Engineering Society.—The Electrical Section of the Buffalo Engineering Society was recently addressed by L. H. Hart on the subject of "Electricity on the Barge Canal."

The Institute of Radio Engineers.—The Institute of Radio Engineers held a meeting on Dec. 5. At this meeting Dr. Frederick H. Millener of the Union Pacific Railroad presented a paper on "Radio-telephony."

Pittsburgh Section, A. I. E. E.—General Willis J. Hulings, retired, addressed the Pittsburgh Section of the American Institute of Electrical Engineers, Dec. 11, on "Why Do We Fight?" G. M. Baker is secretary of this section.

Worcester Polytechnic Institute Branch, A. I. E. E.—G. M. Eaton, head of the railway division, engineering department of the Westinghouse Electric & Manufacturing Company, presented a paper on "The Other Half of Engineering" before the Worcester Polytechnic Institute Branch of the A. I. E. E. on Dec. 7.

New York Companies' Section, N. E. L. A., Attendance Record Broken.—Between 400 and 500 men and women of the New York Companies' Section, N. E. L. A., crowded the Fifteenth Street auditorium on the evening of Nov. 20. W. H. Whitton of the New York Edison Company read a paper, with a discussion by J. A. F. Randolph and A. F. Berry, the subject being "Real Estate and the Central Station."

Buffalo Section, N. E. L. A.—Joseph T. Whitwell, chief of the Bertillon System of the Buffalo (N. Y.) police department, and Caleb J. Coatsworth of the Lafayette escadrille in the French flying corps, were speakers at the last monthly meeting of the Buffalo Section of the National Electric Light Association in the General Electric building. Mr. Whitwell described the method of taking finger prints and filing the prints so that they are immediately available in the identification of an individual, and Mr. Coatsworth told of scenes along the battlefront at Verdun.

Idaho Society of Engineers.—At a recent meeting of the Idaho Society of Engineers at Lewiston, Idaho, two papers were delivered on the water-power possibilities in that section, as follows: "The Distribution of Water in the Upper Snake River Basin," by S. E. Vance, Jr., of the State Engineer's office at Boise; "Power Developments Possible and Proposed in the Lower Snake River Valley," by Robert A. Foster of Clarkston. Mr. Foster made extensive investigations and study of this subject while manager of the Lewiston-Clarkston Light & Power Company.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

New York Electrical Society.—At the next meeting of the New York Electrical Society on Dec. 20 Frank M. Leavitt, inventor of the Bliss-Leavitt torpedo, will give "a brief historical sketch on the development of the torpedo," and W. A. LaDue of the Public Service Electric Company of Newark, N. J., will give an address on "Aerial Cable Construction," illustrated with motion pictures.

Ice Manufacturers Operating Central Station Plants Meet.—The Western Ice Manufacturers' Association, in twentieth annual convention at Kansas City, Mo., Nov. 21 to 23, devoted much time to discussion of cost-accounting methods and to the necessity of such systems under present conditions. There was almost unanimity among the manufacturers who have "side lines" that cost systems are imperative to ascertain where net profits are going and what branch of the business needs readjusting. Many of the ice manufacturers who operate electrical central stations frankly said that the ice plants had been carrying the electrical service, although they had never taken the trouble to get their cost sheets down to the point of actually showing it. There seems to be a tendency among ice manufacturers to confine their efforts to manufacturing ice and to leave central station work to other interests. With the greater facilities for securing service from central stations there is also said to be a more important trend toward raw-water ice manufacturing, with the purchase of power and light from a central station.

San Francisco Jovian League.—An old-timers' meeting of the San Francisco Jovian League was held on Nov. 28 at which tribute was paid by a record attendance to six "old-timers" of the industry on the Pacific Coast. Those to whom signal honor was accorded were: H. V. Carter, formerly of the Pacific States Electric Company; Frank Smith, Western Electric Company; E. B. Strong, *Journal of Electricity;* S. V. Mooney, John A. Roebling's Sons Company; T. A. Addison, General Electric Company, and John A. Britton, Pacific Gas & Electric Company. Mr. Britton spoke of men not present to whom he said yet greater honor was due for their pioneer part in the electrical field. He named particularly John Martin, Eugene De Sabla and R. R. Colgate. The first-named had the courage to plan a hydro-electric project which set an example for the whole world; the second had the ability to convince others of the feasibility of the plan, and the third had enough confidence in its future to advance the $600,000 which made the start possible.

Brooklyn Company Section, N. E. L. A.—The November meeting of the Brooklyn Company Section, N. E. L. A., held on Nov. 20, was attended by a large audience, there being about 600 members of the section present. A paper entitled "Our Part in Winning the War" was read by I. T. Smith of the sales department and was discussed by various members of the section. This is the first paper to be presented in the 1917-18 competition, which is being carried on along the same lines as heretofore, the winner to receive $50 in gold. W. F. Wells, vice-president and general manager of the Brooklyn Edison company, made a very interesting address, as did F. Smith of the New York Telephone Company.

New York Chapter of the A. A. E.—The American Association of Engineers has organized a local chapter in New York City. Headquarters have been established at 220 West Forty-second Street. Temporarily meetings are being held at the Hotel McAlpin, Broadway and Thirty-third Street. Up to the present time these meetings have been mainly devoted to the work of the organization. This is now nearing completion, and the society will soon be in a position to engage in constructive work along the lines which have been followed by the national association. The next meeting will be held on Dec. 17. One of the members of the chapter will deliver a short talk on "Subaqueous Pile Driving."

Electrical League of Cleveland.—The Electrical League of Cleveland, Ohio, did some excellent work in the campaign for Y. M. C. A. funds for army work recently. A complete military staff organized for war work managed the affair, with officers as follows: Major General, J. Robert Crouse; brigadier general, Norman Anderson; adjutants, F. C. Maxheimer and H. J. Wright; aide de camp, D. B. Hopkins; quartermaster, R. S. Dunning; advisory board aviation corps, Col. H. S. Greene, Col. G. S. Milner, Col. F. C. Foster, Major Roy Davis (110 girls), Major Charles B. Gray (95 girls), Major G. W. Thompson (110 men); colonel of cavalry, C. R. Matheny; lieutenant-colonel of cavalry, R. S. Ingle; cavalry captains (fourteen men to company), M. H. Blakeley, F. M. Grant, E. J. Bonsor, C. A. Kuehn, O. M. Friestand, E. H. Spalding, O. N. Jones; cavalry regulars, 100 men; colonel of artillery, J. M. Smith; lieutenant-colonel of artillery, F. R. DuGuay; artillery captains (fourteen men to company), R. A. Parkinson, F. P. Harris, B. H. Decker, G. A. Morrell, J. T. West, B. J. Spitzig, A. F. Schefft, W. L. Bell; artillery, 100 men. Stands, with large milk cans topping them, were placed at street corners, in retail and department stores and at every other point of vantage in the city. They were attended by young men and young women who volunteered to assist the Electrical League in its campaign.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

T. J. Spragle has been appointed local manager of the Kentucky Utilities Company at Elizabethtown, Ky.

L. M. Russell, for the last four years city engineer of Elkhart, Ind., has joined the engineering staff of Arthur J. Sweet, consulting engineer, Milwaukee.

Ernest L. Shotwell has been transferred from the post of superintendent of the Kentucky Utilities Company at Versailles, Ky., to be superintendent at Somerset, Ky.

Laurence H. Parkhurst, formerly manager of the bond department of the Old Colony Trust Company, has been elected a vice-president of the Electric Bond & Share Company.

Donald Stewart, formerly manager of the Baton Rouge (La.) Electric Company, has been transferred to New London, Conn., where he is general superintendent of the Connecticut Power Company.

William J. Hardaker, Reading, Pa., for the past twenty-five years connected with the Reading Transit & Light Company, has been appointed general superintendent for that company and the Metropolitan Edison Electric Company interests in Lebanon County.

Alex D. Bailey, for the last eight years assistant engineer of the Fisk and Quarry Street stations for the Commonwealth Edison Company, Chicago, has been appointed chief engineer to succeed Olaf E. Oleson, who is now president and general manager of the Edwards Valve & Manufacturing Company, Chicago.

R. N. Ehrhart, chief engineer of the condenser department of the Westinghouse Electric & Manufacturing Company, has resigned to take up his duties as president and consulting engineer of the Sedar Coal Company. He has been retained also as consulting engineer by several engineering firms and by the Westinghouse company.

Davis H. Tuck, until recently assistant physicist for the United States Public Health Service, has resigned to accept the position of commercial engineer for industrial and street lighting with the Holophane Glass Company, New York City. Mr. Tuck was graduated from the Massachusetts Institute of Technology in 1911 with a degree of B.S. of electrical engineering. For three years he was with the photometric department of the United States Bureau of Standards at Washington, and since then has been illuminating engineer for the United States Public Health Service division of field investigation of industrial hygiene. While in this work he made a study of the status of illumination in the garment industry in New York City, the steel industry in Pittsburgh and public buildings in Washington, and he has co-operated with the Industrial Commission of Wisconsin in inaugurating its campaign for better lighting in the State, being a member of the Wisconsin committee for drafting a new code of lighting legislation for that State. Mr. Tuck will be in charge of the industrial lighting department of the Holophane Glass Company

J. B. Stewart, Jr., has been made assistant general manager of the Mahoning & Shenango Railway & Light Company, with offices at Youngstown, Ohio. Mr. Stewart has been with this company since 1913, when he became safety and efficiency engineer and superintendent of freight. Subsequently he was appointed superintendent of equipment and traffic and was then made assistant to the general manager, Richard T. Sullivan. Mr. Stewart is a graduate of the Massachusetts Institute of Technology. He has been employed on the Middlesex & Boston Street Railway, Newtonville, Mass.; the Buffalo & Lake Erie Traction Company, Erie, Pa.; the Elmira, Corning & Waverly Railroad, Waverly, N. Y., and the Lehigh Valley Transit Company, Allentown, Pa.

Leonard S. Cairns, assistant general manager of the Manila Electric Railroad & Light Company, Manila, P. I., has been appointed general manager of the Eastern Pennsylvania Railways Company, Pottsville, Pa., by the J. G. White Management Corporation, New York City, the operating manager of both companies. Mr. Cairns has arrived in the United States and has assumed the duties of his new position. He succeeds L. H. Palmer, who lately became assistant to the president of the United Railways & Electric Company, Baltimore, Md. Mr. Cairns upon leaving high school entered the employ of the Twin City Rapid Transit Company at Minneapolis, Minn., and, after several promotions, was made general superintendent of that company. In 1912 he was employed by the J. G. White Management Corporation to fill the position of assistant general manager of the Manila Electric Railroad & Light Company.

Theodore Malm, who for the last six years has been electrical and mechanical engineer for various Mackenzie-Mann interests, including the Toronto Railway Company, Toronto Power Company, Toronto Electric Light Company, Toronto & York Radial Railway Company, Toronto Suburban Railway Company, London Electric Company, Suburban Construction Company, Canadian Northern Railway Company, etc., has established two companies. These are the Railway & Power Engineering Corporation, Ltd., and Theo. Malm & Company, with offices in the Canadian Pacific Railway Building, Toronto, Can. The Railway & Power Engineering Corporation will deal in railway, light and power equipment, and Theo. Malm & Company will undertake surveys, plans and estimates for the development of electric power, prepare plans, estimates and specifications and supervise the work of electric street and interurban railways and mining electrifications, as well as complete systems for the generation, transmission and distribution of electrical energy for commercial purposes and industrial plans.

A. G. Cobb, commercial manager of the Commonwealth Electric Company, Summit, N. J., has resigned, effective Jan. 1 next. Mr. Cobb is trying for a commission in the Ordnance Officers' Reserve Corps. He has been connected with the Summit company since Jan 1, 1917, going there from Uxbridge, Mass., where for three years he was new-business manager of the Worcester Suburban Electric Company.

Stanley V. Walton, commercial manager of the Pacific Gas & Electric Company, has handed in his resignation, which is to take effect Jan. 1. In the years during which Mr. Walton has held this position he has taken an active part in co-operative movements and has served on many inter-company committees. His retirement is caused by the fact that private interests will hereafter require practically all his time. Mr. Walton was born in California and received his electrical engineering education at the University of California, from which he was graduated in 1904. In January of the following year he entered the employ of the California Gas & Electric Corporation, the predecessor of the Pacific Gas & Electric. Two years later he was appointed commercial manager, which position he has held up to the present time. He has been prominent in N. E. L. A. affairs and has served as a member of the executive committee of the Commercial Section.

Obituary

C. O. Smith, manager of the Lewis County Light & Telephone Company at Morton, Wash., was recently found dead at the power plant of the company on the Tilton River. The cause of his death is unknown.

Julius Andrae, the founder of Julius Andrae & Sons Company, electrical jobbers, Milwaukee, Wis., died suddenly at the age of eighty-eight, on Dec. 2. Julius Andrae was born in Meissen, Saxony, in 1829, came to America in 1854, and established himself in business in Milwaukee in 1855. Later he engaged in the business of supplying tool boxes for the government and laid the foundation for the electrical company of which he became the head.

William D. Kearfott, president of the Kearfott Engineering Company, died on Nov. 12 at the age of fifty-three years. In the engineering profession Mr. Kearfott began work with the Morton Pool Company of Wilmington, Del. Later he was associated with such well-known manufacturers as the International Navigation Company, the Worthington Steam Pump Company and the Warren Steam Pump Company. At the time of his death he was head of the Kearfott Engineering Company, New York City, which he organized two years ago.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

STOCK REDUCTION GOING FORWARD AS YEAR CLOSES

Buying Largely to Fill Commitments with Difficulty in Obtaining Goods Actually Needed, Though No Reservations Are Now Being Made

With the approaching end of the year, as jobbers and dealers reduce their stocks to the minimum level, manufacturers and producers are keeping in close touch with conditions with a view of making their selling plans for next season. Changes are constantly occurring in the stock of staples and specialties, caused not only by the natural outgo but by peculiarities in the market. Priority order shipments are so numerous that commercial business has been hampered and in some instances seriously disturbed. Therefore, with deliveries "up in the air," no one is in a position to say what may be the trade situation even a week or ten days ahead.

December is a slowing-down month, with jobbers and dealers reducing stock at every opportunity, going under the market occasionally to dispose of merchandise of which they are either on the long side or which they wish to close out altogether. The buying is to fill requirements only, with no special articles predominating, although where a shortage is evident orders—staples almost invariably—for early delivery in the new year, when not obtainable sooner, are reported. There is no disposition to load up. The trouble is to obtain goods that are actually needed and to know if orders can and will be filled beyond a doubt. Unless this is provided for by unquestioned credit standing or anticipation, they are likely not to be forthcoming. No goods are being held in reserve.

A distributer of prominence when questioned about this said that no reservations are being made for any one. Should a buyer inquire for anything and it be in stock or obtainable the quotation must be accepted and the requisition filed at once. No one is being waited for as a matter of convenience these days. The same conditions apply to shipments from distant points. If the consignee is in a hurry for the merchandise he is informed the goods have passed from the factory, but when they will be delivered no one can tell. If the freight embargo intervenes, the information is passed along. That ends the matter—further complaints are not entertained.

EDISON ELECTRIC APPLIANCE COMPANY IS INCORPORATED

Capitalization, Officers and Certain Commercial Plans of Hotpoint, Hughes and General Electric Heating Devices Merger Announced

Incorporation is announced of the Edison Electric Appliance Company, Inc., under the laws of the State of New York. This company will take over as of Jan. 1, 1918, the Hotpoint Electric Heating Company and the Hughes Electric Heating Company (with the exception of certain foreign rights, particularly the Canadian business of these companies), and the domestic or household heating device business of the General Electric Company, as explained in the Electrical World for Nov. 17.

The industrial heating device and furnace business will not be transferred by the General Electric Company to the new company.

The new company, it is announced, will devote itself actively to the question of standardization of the various devices, which, it is believed by the incorporators, will lead to greatly improved commercial conditions in the distribution of these products by central stations, jobbers, dealers and other distributing agents.

The new company will operate three manufacturing plants—the Hughes factory at Chicago and the two Hotpoint factories, one at Chicago and one at Ontario, Cal. The General Electric Company's heating-device manufacture now carried on at Pittsfield will be removed to the Hotpoint and Hughes factories at Chicago. Commercial headquarters of the company will be at Chicago. The board will consist of Willis H. Booth, chairman; George A. Hughes, president; A. K. Baylor, vice-president; E. H. Richardson, A. F. Vaughan, G. F. Morrison, C. E. Patterson and H. C. Houck. W. H. Booth and E. H. Richardson are at present officers of the Hotpoint company and Messrs. Hughes and Vaughan of the Hughes company. P. H. Booth, now sales manager of the Hotpoint company, will act as sales manager of the new company. The complete factory, engineering and commercial forces of the Hotpoint and Hughes companies will go over to the new company. Certain of the commercial and engineering representatives of the General Electric Company's heating-device department will go with the new company. This list will include J. D. A. Cross, who has charge of the General Electric Company's heating-device sales, and C. P. Randolph, engineer in charge of heating-device production at Pittsfield, who will both be stationed at Chicago.

It is probable that the new company will continue to sell the three distinct lines of product, namely, the Hotpoint, Hughes and General Electric devices and ranges.

The capitalization of the new company will be divided into 25,000 shares of 7 per cent preferred stock, $100 par, and 30,000 shares of common stock without par value.

One of the purposes of the organization is to effectively organize the merchandising talent throughout the country to promote heating-device sales, and beneficial results from this activity are expected to occur in common with the products sold into the household.

The new company is contemplating immediate extensions at the Hughes factory at Chicago.

THE OUTLOOK FOR 1918 ELECTRIC FAN SEASON

Competitive Conditions Temporarily Hold Up Announcements of Campaign Plans for New Year—Price Higher

About this time the manufacturers of electric fans usually announce their selling plans and price schedules for the coming year. Some of them have followed the customary rule, but not all. Heretofore a differential of from 75 cents to $1 was made between direct-current and alternating-current fans, on account of an increased cost of manufacture. One of the leading manufacturers this year, it is understood, in placing his schedules before the trade puts both types on the same price level.

The expectation that an advance in fans would be made for 1918, on account of the increased cost of production and material, as well as a shrinkage in the supply of the latter, have both come true. Fans are marked up on an average of $3 apiece, and in some models even more.

It is learned that the manufacturers generally had their schedules about ready for distribution when this leveling-up price announcement became known. Thereupon the proposed selling plans were held up for further consideration. The contention that one type costs more to manufacture than the other is generally expressed, but whether the

concern referred to above will coincide with this view and change its list accordingly remains to be seen.

Manufacturers knowing the stock of material was none too stable or plentiful closed their contracts in the spring, some making arrangements as early as March last. While these commitments stand, it is a question whether the merchandise can or will be delivered. As it stands, possibly a priority certificate from the War Industries Board may be necessary to have the material shipped, excepting in the case of very large producers who may have anticipated this crisis by ordering raw stock far ahead.

A meeting of the various sections of the Associated Manufacturers of Electrical Supplies in New York City is called for Dec. 13 to confer with the trade members of the Committee of National Defense on this among other matters of importance. In fact, it is stated that the future manufacture and supply of material on the entire line of electrical goods will come up for discussion. There is a probability that certain specialties and even staples may be designated as non-essentials by the government board, and suggestions and plans to avoid such a catastrophe will be offered for submission to the authorities.

There is a difference of opinion concerning the supply of fans for 1918. Manufacturers who should be in a position to know declare a shortage is bound to occur. Others equally well fortified are of a contrary mind and say they stand ready to fill all orders, unless the unforeseen should happen, as may be likely should a curtailed supply of material, not now figured upon, ensue. One of these companies is now in the field making contracts with distributers and jobbers. It avers that the buying has fallen off, the distributing trade taking on even less than last year, when a marked shortage followed during the summer of 1917. Naturally this jobbing attitude comes in for sharp criticism on several counts, especially that of shortsightedness. Another company will make an effort to introduce its quantity basis plan of selling, a marked success and satisfactory to both the seller and buyer in its other lines.

METAL MARKET SITUATION

Large Contracts for Wire Supplied by Electrical Manufacturers—Tin Goes Higher

On a governmental requirement electrical supplies manufacturers not long ago furnished 1,000,000 ft. of copper wire, apportioned among different plants to expedite its production and stabilize conditions, in thirty days. Subsequently 20,000,000 ft., similarly distributed, of No. 12 copper was furnished and delivered in ten days to the authorities for the cantonments and other military and naval purposes. Other orders from the same source may follow. Small consuming interests are having no trouble in obtaining all the copper required in less than car lots at 23.50 cents plus the 5 per cent rate officially established. Larger concerns are not suffering for metal and some are reported as having a surplus upon which to draw. One of the largest consumers of copper wire is desirous that the trade should be more familiar with the price and condition of base, in contrast with rather questionable reports in circulation. Again tin has increased in price, and the supply is still short.

NEW YORK METAL MARKET PRICES

	Dec. 3	Dec. 10
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	27.00 to 29.00*	27.00 to 29.00*
Lead, trust price	6.25	6.25
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	7.70 to 7.80	7.67½ to 7.77½
Tin, Straits	81.00	86.00
Aluminum, 98 to 99 per cent.	34.00 to 36.00	34.00 to 36.00

OLD METALS

Heavy copper and wire	22.50 to 23.00	22.50 to 23.00
Brass, heavy	14.50 to 16.50	14.50 to 16.00
Brass, light	10.50 to 11.50	10.50 to 11.00
Lead, heavy	5.75 to 5.87½	5.75 to 5.87½
Zinc, old scrap	5.00 to 5.50	5.00 to 5.50

*Nominal.

THE WEEK IN TRADE

WITH the extraordinary sale of electrical equipment for new industrial enterprises of magnitude, and with strong buying of jobbers and dealers, the volume of trade is fast approaching a new high record. Priority shipments on War Industries Board certification are characterized as excessively exasperating, not only to the transportation companies, but also in commercial circles. Deliveries remain undependable in nearly all sections, to the annoyance of everybody affected. Motors and transformers are short, pole material increasing in price; electric ranges, appliances, sewing machines, etc., command a large and wide sale—in certain parts enormous. Orders on 1918 business are being booked. The December sales totals exceed those of November.

Collections are reported fair in some fields, elsewhere quite satisfactory. Credits are critically investigated and accommodations cautiously accorded on new accounts.

NEW YORK

Considerable activity is noticeable in the local market on various lines of goods. To be sure, holiday specialties are in the strongest demand, which is greatly stimulated by the generous and effective publicity campaigns carried on by the manufacturers. Nevertheless, staples are purchased for immediate calls, in not a few instances as subsidiary war material orders. Deliveries have improved on certain merchandise, but still are a disturbing element, embargoes and numerous priority shipments upsetting all calculations. Prices on some materials have advanced.

Collections are holding up in a surprising manner for December. Credits continue to receive the closest attention.

CHRISTMAS LIGHTING OUTFITS.—Reports that there would probably be a sharp cut in the supply of Christmas trees in the metropolitan district suggested a corresponding curtailment in the buying of festoons or lighting outfits. It developed on inquiry from reliable sources that the stock of trees will be as usual in quantity. The supply of outfits is abundant, and no falling off in buying is noted. In many instances contracts were signed months ago and deliveries to retailer are now being cleaned up.

INSULATORS.—An advance of 15 per cent on glass insulators became effective Dec. 1, but it was not retroactive, as was expected by some buyers. Stock is none too plentiful, but is easier than a month ago.

LAMP CORD.—There may possibly be a short supply on some grades of lamp cord, but a manufacturer whose plant makes it an exclusive product says any quantity—even to 100 per cent orders—may be obtained. Prices are high.

FLEXIBLE-STEEL CONDUCTORS.—A carload reached New York early in the week, quite to the surprise of the distributing trade. It was rapidly absorbed and more could have been easily sold in a rather short market.

SMALL MOTORS.—Deliveries, which were four weeks back on small motors a month or more ago, are now improved—very much so, according to some manufacturers. It is held this has been brought about by a lessened demand. Prices remain steady, but an advance is looked for after Jan. 1. A recent large order for war purposes materializing suddenly—"over night," as it was described—rather upset the market.

CROSS-ARMS, ETC.—Further difficulty is being experienced with Pacific Coast fir cross-arms. Recent governmental requirements for lumber about swept the Western market bare.

CORD.—All cords with a fine strand are difficult to buy, deliveries being six months behind.

LIGHTING FIXTURES.—Some jobbers hold that lighting fixtures will rapidly increase in price and will become scarce, owing to the fact that the War Industries Board will curtail the manufacture of bowls, globes and shades—in fact, has declined to furnish sufficient fuel to glass works turning out these goods. Other concerns are equally positive in de-

claring that the stocks of fixtures are unusually strong, on account of the sharp falling off in the demand for building operations. One glass manufacturer is advising jobbers to buy while they can, while on the other hand one of the local jobbers is offering a lot of 1000 lighting fixtures at a sacrifice price in order to realize and reduce his stock.

TRANSFORMERS.—Where a short time back the deliveries of transformers and medium-size motors were rather uncertain, now the situation shows a marked improvement. A leading manufacturer states that not only has the demand dropped but orders are being canceled where possible or held up by central stations and public utilities, which are unable to finance themselves sufficiently. Prices, however, are steady.

CARBONS.—Carbons for electrical uses may no longer be exported from France to the United States and allied countries without special license. Consul General Thackara reports from Paris that the permits for such exportation which formerly modified the embargo of Dec., 1914, affecting these articles have been withdrawn by a ministerial order of Nov. 19. Special applications must now be made for permission to export these goods to any country.

CONDUIT PIPE.—One of the largest producers of rigid conduit states that it is difficult to get any stock worth speaking of, let alone an accumulation. To add to his embarrassment in this respect customers are clamoring for deliveries under accepted contracts. Prices are unchanged.

SOCKETS.—Inquiry at the office of one of the leading manufacturers brought out that on standard lines and sizes the supply is growing short. Prices, it was stated, are not likely to advance.

REFLECTORS.—There is a good supply of reflectors in a majority of types held in stock by manufacturers. Shipments go forward as rapidly as the freight embargoes permit.

COLLECTIONS AND CREDITS.—December collections so far seem to be making as fine a record as those for November. Credits are carefully looked after, particularly on the opening of new accounts. Losses for the entire year have been small, and the run of buying on the part of dealers is along lines of actual needs and confined to useful articles rather than novelties. Stocks are being reduced as rapidly as possible with the close of the year.

JOBBERS' STOCKS.—A careful inquiry among leading jobbers reveals the fact that the buying this month is only to fill requirements. This, it developed, will continue until after Jan. 1, when the buying of staples is expected to take an upward turn.

BOSTON

General business continues to be good, but it is overshadowed and dominated by the "priority" given to all government requirements. Some factories would be able to make improved deliveries except for the generally unsatisfactory condition of railway traffic and the resulting embargoes. Price changes are largely negligible, and collections are only fair. There seems to be some differences of opinion regarding "trade acceptances." Their early and general adoption, however, would seem to combine patriotic necessity and a good business method of relieving the situation.

Holiday trade is coming forward but is not expected to equal that of a year ago. Labor conditions are not greatly changed, except that the Western Electric Company's strike is now settled, thus removing another disquieting situation.

LAMPS, RADIATORS AND RANGES.—Good and improving business is reported from week to week, this being especially true of government requirements, which appear to cover 50 per cent of the total.

STORAGE BATTERIES.—Conditions have not materially changed, being dominated by government requirements, these easily holding first place here as elsewhere.

HOUSEHOLD APPLIANCES.—Business continues to expand, but is still below that of last year.

MOTORS.—Demand outstrips supply, and deliveries are very far behind. Government orders are piling up, and their "priority" still further delays delivery to regular patrons.

CHICAGO

Manufacturers are trying to induce jobbers in the Middle West to stock up on staples. The theory is advanced that materials are going to be hard to get and that the fellow who has a stock will be lucky. Some of the jobbers are stocking up, but others are watching the action of the price boards now meeting at Washington to see what will happen to government prices on steel and copper when the time for a change comes. No one is ready to hazard an opinion on whether the price revision in copper and steel, if the price is revised, will be upward or downward. Business in the territory remains satisfactory as to volume, with some unsettlement in prices, owing to the fact that it was necessary for certain firms to meet competitive conditions.

COPPER WIRE.—Prices in general remain on a 34-cent and 35-cent base. Occasionally some manufacturer comes into the market with a lower price temporarily. January quotations on copper are lower, indicating probable price reduction after the first of the new year.

GLASSWARE.—As was predicted, glassware and glass insulators are advancing in price, the increase amounting to about 20 per cent so far.

IRON CONDUIT.—Some manufacturers are quoting card 38 on all sizes up to 2 in. and are asking 5 per cent premium on sizes 2 in. and larger. While some jobbers have good stocks they are worried about replenishing them.

SOCKETS.—On ⅛-in. key, keyless and pull sockets one jobber has reduced prices on small quantities 10 per cent.

LAMP CORD.—No. 18 lamp cord is cheaper in some quarters.

NON-METALLIC FLEXIBLE CONDUIT.—The standard sizes—¼-in. and 7/32-in.—are being quoted 10 per cent lower by one of the local jobbers.

PORCELAIN.—Knobs, cleats and other porcelain ware appear to be getting ready to follow the upward trend of glass. One manufacturer's representative stated he had sold more porcelain in November than in all of the preceding months of 1917. It is probable that the porcelain manufacturers are letting their regular trade buy heavily before an advance will be made. Jobbers' prices on porcelain have not changed.

ELECTRIC RANGES.—Orders have continued to come in. During the months of September, October and November electric range business with some of the companies has been equal to what it was in the spring months. While some of the larger buyers are out of the market, a greater number of smaller buyers have come into the market.

ELECTRIC APPLIANCES.—The best sellers in the Christmas season seem to be air heaters, round grills, toasters and percolators of both the pot type and the loving-cup type. It is reported that the big department stores are buying very cautiously.

SIGN FLASHERS.—On account of the additional argument which the Fuel Administrator's order on electric signs has given to sign-flasher manufacturers there has been a considerable stimulus to this branch of the trade.

CONTRACTING IN EASTERN OHIO.—The section of Ohio which lies east of the line through Cleveland and Massillon is experiencing such favorable industrial conditions that practically every electrical contractor in the territory has more work booked than he can handle between the present time and February. This situation has been brought about not only by increases in factory facilities, but also on account of the shortage of houses, which has made it necessary to build more residences and to put into shape property which was hitherto unrentable.

ELECTRIC SOLDERING IRONS.—The activity in the many shipyards on the coast is making an extraordinarily broad market for electric soldering irons. Two concerns in the Middle West have recently received orders aggregating $26,000 for these devices.

ASH-HANDLING EQUIPMENT.—The demand for this sort of machinery created on account of the fact that it reduces the number of men necessary to handle any power plant, is extraordinarily active. One customer recently shipped an outfit weighing 4 tons from Chicago to New Hampshire by express.

ATLANTA

Business reflects sustained activity in many directions and underlying strength in nearly all lines of the electrical field. What is especially important is the fact that at the bottom general conditions are wholesome, and more so than six months ago, as there is less competitive and excited buying at this time. There are still many drawbacks in the general situation, and the new and extraordinary problems which are being encountered hinder progress in electrical lines as well as the industrial field.

The seriousness of railroad congestion is evidenced by the unprecedented measures now being taken to relieve the pressure. Outside of shipment difficulties the most serious subject the South has had to face lately is the fuel shortage. A number of central stations depending on coal deliveries are in dire straits, and in some instances output had to be curtailed. In addition to this problem quite a number of the large hydroelectric companies have experienced a drought during the last few months which lowered reserve water capacity and has created an acute situation in that a quantity of energy is now being supplied by supplementary steam plants. This, too, has tended to make the solving of the fuel problem more difficult.

The Langley Mills, Langley, S. C., have just closed contracts for electrical apparatus totaling about $80,000, which will include 125 motors aggregating 2400 hp., four-frame and group drive, also two 315-kva., 150-r.p.m. vertical water-wheel generators. The Warren Mills, Warrenville, S. C., have closed an apparatus contract approximately for $41,000 for twenty-three motors, aggregating 1550 hp. group drive. Both of these mills will be supplied with energy from the Augusta-Aiken Railway & Electric Corporation. Delivery about July, 1918.

INDUSTRIAL LIGHTING.—Business in this line has taken quite a boost this year, due to activity in textiles and other industrials requiring more and better illumination. The sale of steel reflectors has increased over 200 per cent for the year to date, deliveries on these being excellent. The lamp demand is evenly distributed between the 200-watt, 300-watt and 500-watt nitrogen-filled. Reliable sources report that there is some very big business in sight.

TELEPHONE EQUIPMENT.—The demand for increased efficiency has opened up a very lucrative field for intercommunicating systems in the large industrial plants, which heretofore has been practically dormant. Jobbers' sales show a big increase in this year's business, and no curtailment in the call is noted, although prices are slightly higher. Shipments are reported as being exceptionally good under the circumstances.

SPOTLIGHTS.—An excellent business is being carried on and the jobbers are unable to handle the automobile demand. Manufacturers are away behind on deliveries and shipments are growing longer. Prices remain unchanged.

SPECIALTIES.—Vacuum cleaners and sewing-machine motors are moving fast. Although headlight heaters have advanced about 20 per cent, the sales for this year will be record-breaking, in face also of poor deliveries.

WIRING SUPPLIES.—The demand for knobs, cleats and miscellaneous porcelains is very strong and shipments are fair. Sockets and receptacles are being turned over rapidly and local lots are grabbed up quickly. Local jobbers' stocks are in pretty fair shape, but anticipated future big business is reflected by the fact that substantial orders are being placed for delivery early in 1918.

SEATTLE

Activity continues in the electrical trade, government and shipyard orders sharing about equal prominence and dominating business during the last week. Heavy orders were placed by both the Bremerton Navy Yard and the Seattle shipyards for power apparatus. Orders from American Lake cantonment during the week dropped to practically nothing. The buying of electrical fixtures and appliances for up-Sound fort cantonments is very light, but is expected to increase shortly. Christmas sales of electrical household equipment are increasing daily.

Preceding the culmination of holiday buying, about Dec. 23, local shipyards will pay approximately $1,000,000 in wages to employees, who are expected to invest heavily in staple electrical gifts. The dealers' plans for securing this business are carefully laid and are being successfully executed. Several of Seattle's largest dealers report the sale of electric sewing machines enormous, closely seconded by washing machines, irons and other electrical devices. The volume of sales of farm-lighting outfits increased considerably during the past week. Prices show no outward signs of fluctuating. Orders are being placed as needed, especially by retail dealers.

The President's order forbidding alien enemies approaching within 100 yards of the waterfront will affect more than 7000 persons in Seattle. The order will accentuate labor scarcity and work tremendous hardship on firms conducting waterfront business, particularly firms exporting and importing. Waterfront industrial plants will also suffer.

Both jobbers and retailers confidently expect business along all lines during December to exceed by far November's volume. Sales during the last ten days justify their prediction. The building department claims an increased activity. Fixture dealers report increasing sales. A concerted effort contemplated by architects and contractors is for encouraging building on the theory that labor and materials will never be lower.

With the settlement of the telephone strike service is again normal. The Western Pine Manufacturers' Association at Spokane voted to establish an eight-hour day in logging camps and mills. The government has asked the logging companies to continue operation beyond the holiday period, stating that the government is not getting 50 per cent of the airplane stock required.

The railroads centering in Seattle have applied for authority to discontinue intraterminal service. Unless opposed they will put an embargo on the use of cars for drayage purposes within the city limits.

Shipyards in Tacoma are preparing for a period of unprecedented activity. Applications were presented to the municipal lighting department for increased lighting facilities in several of the largest plants to accommodate night shifts. The demand for floodlighting systems is heavy.

A shortage of labor is the most vital problem that the Northwest industries are contending with. The problem facing mills and logging camps is serious. Smaller industries are also feeling the press. The department of labor and the United States Shipping Board, through representatives, are trying to analyze and devise means of relieving the shortage in the Northwest, as it affects the government war program. The chief aim of the departments will be to outline a plan for bringing 20,000 additional shipbuilders to the Pacific Coast, the Puget Sound country particularly, to increase the output of Seattle's shipyards. The commercial economy committee of the State Council of Defense has asked dealers in all lines to extend credit for not to exceed thirty days. Collections remain in a satisfactory condition. Credits are well in hand.

SAN FRANCISCO

Industrial-plant work is keeping contractors busy in San Francisco and adjacent cities. Building activities in the smaller towns, particularly in the San Joaquin Valley, continue and have developed quite a good business for contractors both large and small.

Small motors are in demand but deliveries are very slow. Motors above 15 hp. are not available from Pacific Coast stock. Transformers are almost impossible to obtain. No improvement is shown in factory shipments, which have been slow for some time. The supply of switches is fair. The demand for storage batteries, used principally for farm purposes, factories and automobiles, is brisk. Flashlights also show a steady demand. Deliveries are such that practically all orders can be filled. Retailers report a fair demand for vacuum cleaners, flatirons, percolators, etc. In fact, the demand for electrical goods in general is holding up practically as well as is usual during the pre-holiday season. Collections from dealers and contractors are about the same as last month, which was a little slower than usual.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard packages or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B.&S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List to $61.00
Coil to 1000 ft	10% to $59.17
	No. 12 Solid
Less than coil	List to $71.00
Coil to 1000 ft	10% to $68.87

Twin-Conductor

	No. 14 Solid
Less than coil	List net to $105.00
Coil to 1000 ft	$70.00 to 10%
	No. 12 Solid
Less than coil	List net to $135.00
Coil to 1000 ft	10% to $130.90

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+10%
Coil to 1000 ft	—10%
	No. 12 Solid
Less than coil	+ 10%
Coil to 1000 ft	—10%

Twin-Conductor

	No. 14 Solid
Less than coil	List to + 10%
Coil to 1000 ft	List to — 10%
	No. 12 Solid
Less than coil	+ 10%
Coil to 1000 ft	—10%
	No. 12 Solid
Less than coil	+ 10%
Coil to 1000 ft	— 10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg.	34%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to 12%
1/5 to std. pkg	List to 20%
Std. pkg.	28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28 to .285	.29 to .295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp	$75.00	$69.75
3/8-in. d. stp	75.00	72.00
1/2-in. s. stp	100.00	93.00
1/2-in. d. stp	100.00	96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.25-78.75	71.25-71.75
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.— $25.00-$55.00	$20.50-$24.50	$20.00-$21.50
1/4-in.— $28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PRICE 1000 FT.—CHICAGO

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.— $36.66-$55.00	$35.00-$37.50	$22.50-$24.75
1/4-in.— $40.00-$60.00	$27.00-$30.00	$25.00-$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb	4% to 6%	7% to 9 %
2500 to 5000 lb	6% to 8%	9% to 11%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb	1.3% to 3.7%	4.3% to 6.7%
2500-5000 lb.	3.3% to 5.7%	6.3% to 8.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$5.00 to $6.00
Discount	30%

CHICAGO

List	$5.00 to $6.00
Discount	25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	28%
1/5 to std. pkg	38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

Per 100 Net
Less than 1/5 std. pkg.....$5.00 to $5.75
1/5 to std. pkg..... 4.50
Standard package, 500. List, each, $0.07.

CHICAGO

Per 100 Net
Less than 1/5 std. pkg.....$6.25
1/5 to std. pkg..... 5.25
Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

	Std. Pkg.	List, Each
Regular, clear:		
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.....Net
Std. pkg. 10%

DISCOUNT—CHICAGO

Less than std. pkg.....Net
Std. pkg. 10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

Per 1000 Ft. Net
Less than coil (250 ft.)....$31.00 to $33.98
Coil to 1000 ft..... 25.82 to 27.90

CHICAGO

Per 1000 Ft. Net
Less than coil (250 ft.)....$30.00 to $36.56
Coil to 1000 ft..... 22.50 to 27.42

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100.....$20.00 to $29.00

CHICAGO

Net per 100 .....$19.25 to $24.00

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%	20%
$10.00 to $50.00 list	42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....10%
1/5 to std. pkg.....20%
Std. pkg. 30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....10%
1/5 to std. pkg.....20%
Std. pkg. 30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

Per 1000 Net
Less than 1/5 std. pkg.....$20.00 to $38.00
1/5 to std. pkg..... 19.00 to 26.70
Standard package, 2200. List per 1000, $20.

CHICAGO

Per 1000 Net
Less than 1/5 std. pkg.....$15.80
1/5 to std. pkg..... 14.80
Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N. C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg....	$27.50 to $29.00	$30.75
1/5 to std. pkg....	15.60 to 20.75	21.20 to 24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg....	$11.85	$30.75
1/5 to std. pkg....	11.10 to 11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....Net
1/5 to std. pkg.....20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....Net to 14%
1/5 to std. pkg.....15% to 30%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3. P. S. T.	1.80
60-amp. 3. P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List net to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	—11%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	—5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....List
1/5 to std. pkg.....15%
Std. pkg. 28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....+20% to list
1/5 to std. pkg.....List to —15%
Std. pkg. .....List to —30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	List
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price $6.00
Discount 30%

CHICAGO

List price .....$5.00 to $6.00
Discount .....25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

Per Lb. Net
No. 18, less than full spools..$0.44¼ to $0.49
No. 18, full spools ..... 0.43¼ to 0.45.

CHICAGO

Per Lb. Net
No. 18, less than full spools..$0.57½ to $0.65
No. 18, full spools..... 0.50½ to 0.55.

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11	$15.00-$18.00	$13.00-$14.00	$11.25-$11.50
12	23.25- 27.09	21.30- 23.22	19.35-
10	32.40- 37.80	29.70- 32.40	27.00-
8	45.70- 53.34	41.90- 45.72	38.00- 38.10
6	72.40- 84.42	66.35- 72.35	60.30-

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$13.50	$12.00
12	26.95-27.79	23.41-26.95	19.85-23.10
10	33.24-38.25	30.47-32.72	27.70-30.60
8	47.04-54.27	43.12-45.47	39.20-43.42
6	68.25-84.01	62.05-79.23	55.85-74.90

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 No.

NEW YORK

Per 100 Lb. Net
Less than 25 lb.....$35.25 to $39.25
25 to 50 lb..... 36.25
50 to 100 lb..... 34.25 to 35.25

CHICAGO

Per 100 Lb. Net
Less than 25 lb.....$40.25
25 to 50 lb..... 39.00 to $39.35
50 to 100 lb..... 38.00 to 38.35

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Insulating Material

An insulating material which is said to be fireproof, waterproof, acid-proof and electric-current-proof, composed of chemically treated pulverized waste material which may be molded, stamped or pressed into all special or commercial sizes and shapes, has been developed by Harry A. Dorr. Attention is called to the fact that this material, to be known as "Dorrite," being composed chiefly of waste matter, can be sold at a very reasonable price.

A piece of this insulating material, 3 in. (7.6 cm.) in diameter, ⅛ in. (3.2 mm.) thick, was immersed in water for seventy hours, then subjected to 40,000 volts, and no marks, change in weight or leakage appeared. The same piece was boiled for one hour in cutting oil at 650 deg. Fahr. (343 deg. C.) and stood the same test. A piece 6 in. (15.2 cm.) square and ⅛ in. (3.2 mm.) thick stood a test of 88,000 volts in oil without leakage or breakdown. A piece of the same size was immersed in a 10 per cent solution of sulphuric acid for nineteen days without change.

This material and the finished product will be made by the Dorrite Insulation Company, Inc., 188-192 Culver Avenue, Jersey City, N. J., after Feb. 1, 1918.

Control for Fixtures

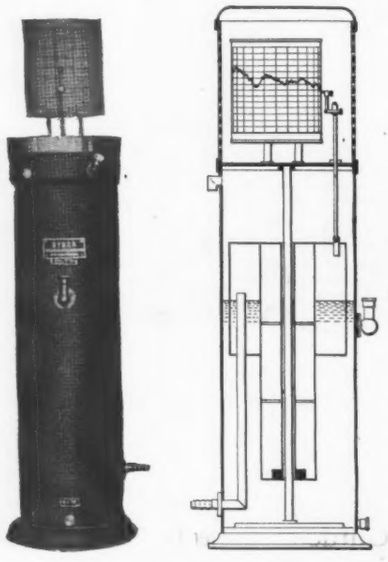
H. A. Bauer of Lansdowne, Pa., has developed a device which provides for lighting either one, two, three or four lamps on a fixture merely by pulling the cord for the corresponding lamp. The construction of the interior of the fixture is shown in the

DEVICE USED IN A SEMI-INDIRECT FIXTURE

accompanying illustration. It will be observed that it consists of a central support on which are lugs for horizontally mounting as many as four pull sockets of any standard make. The upper part of the support is arranged either with some ornamental cover used purely for decoration or for the attachment of a single supporting chain or stem. When it is desired to use three or four chains these are attached to adjustable arms that can be mounted on the central support. These arms can be changed as to length to fit any desired size of bowl.

Pressure Recorder

The Bacharach Industrial Instrument Company of Pittsburgh, Pa., has brought out a pressure recorder, the action of which depends upon but one moving element, that of a float in



TWO TYPES OF RECORDERS

water. The standard apparatus consists of a cylindrical vessel or tank partly filled with water. The pressures to be measured are transmitted to the instrument and act upon the float. The interior of the bell-shaped float communicates with the gas main, the flue or the stack in which the pressure or draft is to be measured. The latter is transmitted to the space below the bell, whereas the space above the bell communicates with the atmosphere. The position of the bell is determined by the difference of pressure within and without the bell, the magnitude of its movement depending upon the design of the float proper and the bell.

A vertical pen rod is attached to the float and carries at its top a pivotly connected pen which charts the position of the float on carefully calibrated recording sheets.

Dead-Ending Clevis

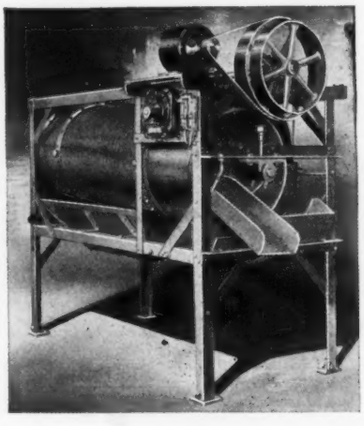
Dead-ending clevises that will anchor a metal-cap strain insulator with any one of the three types of connections, namely, eye, clevis and hook, on the end of a bolt through

FOR THREE TYPES OF CONNECTIONS

the side of a cross-arm or building are being manufactured by Hubbard & Company, of Pittsburgh, Pa. These clevises are forged from flat steel, ¼ in. by 1¼ in. (0.6 cm. by 3.2 cm.), and fit both ½-in. (1.27-cm.) and ⅝-in. (1.6-cm.) bolts.

Magnetic Separator

The Magnetic Manufacturing Company, 610 Enterprise Building, Milwaukee, Wis., has just put on the market a magnetic separator especially designed for use in iron and steel foundries. The foundry refuse or mixed material is shoveled in at one end of the machine, and the sand is sifted out while passing through a revolving screen. The iron and steel are attracted by magnetism to the inside face of the revolving cylinder and are carried up and automatically discharged into a spout which deflects them to the discharge end of the machine, while the



FOR IRON AND STEEL FOUNDRIES

coke, slag and other non-magnetic materials discharge from the lower end of the cylinder. The three products of this machine may be received in wheelbarrows. The machine is motor-driven.

Foot-Candle Meter

An instrument for measuring illumination intensities, based on an arrangement of transparent paper and a standard lamp developed by Dr. Clayton H. Sharp, has recently been designed by the General Electric Company. Strictly speaking, the foot-candle meter, as the device is named, is not a substitute for the photometer but has a field of service distinctly its own. It is small, light and compact enough to be carried anywhere and used for approximate illumination measurements in places where a precision photometer would be unwieldy. It is sturdy and simple, so that it can be handled without fear of breakage, and it is pointed out that its cost is so low as to put it within the reach of even the smallest contractor and make the expense of upkeep a negligible quantity.

The instrument is contained in a neat black metal case 8 in. by 1½ in. (20.3 cm. by 3.8 cm.) in size, and consists primarily of a white opaque paper screen perforated by a line of round holes which are covered with transparent paper. This screen, which measures 5¼ in. by ⅞ in. (13.3 cm. by 2.2 cm.), is fastened to a plate of glass fitted into an opening in the black metal case housing the entire instrument and is illuminated from below by a standard battery lamp of known candle-power. The opaque paper screen is illuminated by the light to be measured, and by comparison of the graded brightness of the holes with the uniform brightness of the surrounding portion of the screen some point of equality is found and a reading is thereby obtained directly in foot-candles from a calibrated scale which is printed on the screen beside the holes.

In order to keep the lamp candlepower constant, a rheostat and voltmeter are provided, which, together with the lamp, battery and screen, complete the instrument. The voltmeter scale has but one graduation in addition to its indices, that at which the lamp voltage is correct for the required candlepower. A hinged cover is provided for the paper screen, which keeps it clean when not in use and protects it from mutilation.

BASED ON AN ARRANGEMENT OF TRANSPARENT PAPER AND STANDARD LAMP

Once set for the proper voltage, the meter is equally accurate in any position and will maintain its accuracy for a considerable length of time without adjustment except of the rheostat. Provision is made for adjusting the voltmeter needle to its zero point, and battery renewals are easily made from any flashlight dealer's stock.

Globe-Holding Clamp

A globe-holding clamp has recently been devoloped by R. C. Hager of Jersey City, N. J., which it is claimed will materially reduce the breakage of large outer globes for street lighting. The device consists of two sheet-metal semi-circular forms connected together at one side by a hinge and at the other by a catch. The inner edge of this form is shaped to fit the flange of the globe, while the outside edge is made to fit over the collar of the post. The outside edge of the form has three L-shaped slots, 120 deg. apart. which allows the form to go over the holding screens that project outward through the collar of the post.

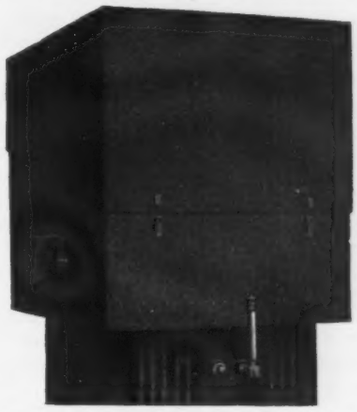
After the form is clamped on the globe it is placed on the post, turned into position and held securely by lugs. It is made waterproof by the introduction of suitable material between globe and holder.

WILL REDUCE BREAKAGE

Outdoor-Type Induction Regulators

Outdoor induction feeder voltage regulators provide a means of obtaining voltage regulation in outlying districts or any other part of an alternating-current distribution system without the expense of housing or attendance, it is said. Being entirely waterproof and self-contained, one of these regulators may be mounted on a platform constructed on poles or on the ground protected by a suitable fence or screen. The only attention required will be a general inspection for oiling the motor bearings and worm-screw mechanism, filling the grease cups and examining the relay contacts at long intervals.

The Westinghouse Electric & Manufacturing Company's outdoor induction feeder regulators consist of a standard type C regulator of the familiar form used for indoor service. The following modifications have been made to adapt it for outdoor service. A steel housing is securely mounted on the top of the regulator tank. This completely incloses the regulator top cover, on which in addition to the operating motor mechanism and secondary relay are also mounted the primary relay, resistor and any other accessories required.



UPPER SECTION OF REGULATOR WITH HOUSING ON TOP

The steel housing has a hinged cover to facilitate the inspection of the apparatus which it incloses. The edge of the top cover of the housing when closed extends down over the edge of the bottom part of the housing, and a shoulder with gasket forms a moisture-proof joint. The housing is mounted on the regulator tank in such a way that it does not interfere in any way with the easy removal of the regulator from the tank. In most cases the proper location of such a regulator is at the center of distribution of the feeder circuit; that is, as close to the load as possible. When thus installed the regulator with proper setting of the primary relay will hold the voltage at the point where it is located at a predetermined value. An outdoor type voltage transformer must be provided and also a low-voltage alternating-current circuit for the operating motor.

This regulator has the advantage, it is pointed out, that all the accessories are mounted in one compartment with all the interior wiring complete when the regulator is shipped.

This regulator is designed for 10 per cent regulation on 2300-volt feeder circuits, and is furnished in four standard sizes, 5¾, 11½, 17¼ and 23 kva. These ratings correspond to 25, 50, 75 and 100-amp. feeders.

Electrical Alloy

A copper-nickel alloy, which, it is claimed, replaces German silver and is permanent and non-corrosive, withstanding higher temperatures than German silver, has been developed by the Electrical Alloy Company of New York City. This alloy is to be known as "Lucero." It is pointed out that it does not contain any zinc and is very useful for rheostats, car heaters, etc. The specific resistance is 290 ohms per mil-foot (48 microhms per inch), and the temperature coefficient is 0.001 deg. Fahr.

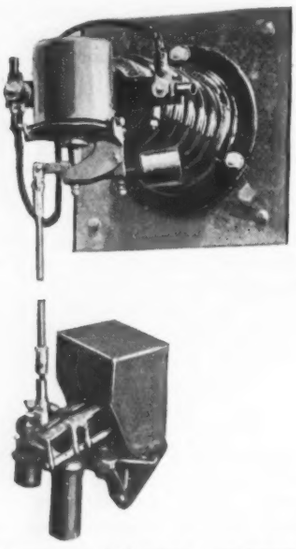
High-Voltage Series Relay

The General Electric Company has recently made several improvements in its high-voltage series relay used for the automatic tripping of oil circuit breakers. As illustrated, the mechanism of the relay consists of two main elements joined by a wooden rod.

The upper element—solenoid, counterbalancing weight and a mechanism for transmitting the motion of the solenoid plunger to the operating rod—is mounted on a high-tension insulator and isolated from ground. The lower element—relay contacts, cover for contacts, calibrating parts, and time-limit arrangement when used—is mounted below the upper element.

The solenoid is connected in series with the circuit, and one end of the coil is electrically connected to the solenoid frame to avoid static stresses. The solenoid coil and mechanism do not require adjustment after installation and thus are not a source of danger to the attendants. When the solenoid or relay operates the motion of the plunger is transmitted through the wooden operating rod to a set of double-break lever-switch contacts which close when the solenoid plunger rises because of overload or short circuit and open again by the weight of the plunger when these abnormal conditions are removed.

The oil-circuit-breaker tripping circuits are the same as when the more common secondary relays are used with circuit-closing contacts. The current adjustments and the time-delay setting are made at the lower end of the operating rod, and of course in safety to the operators. The relay is calibrated from normal to three times normal current. Current calibration is made by the sliding weight. Time-delay adjustments



35,000-VOLT, 100-AMP. INVERSE-TIME SERIES OVERLOAD RELAY

are made by an oil dash-pot. When instantaneous operation of the relay is desired the time-delay features are omitted.

Contacts, mechanism and solenoids are the same for all voltages—that is, from 15,000 upward—but the coils vary in capacity according to the normal ampere capacity of the line. The insulators for mounting the solenoid will vary according to the line voltage and the factor of safety required. This relay is used mostly when the cost of high-potential current transformers for tripping purposes is prohibitive.

Lighting Fixture

The Doerr-Mitchell Electric Company of Spokane, Wash., has developed a lighting fixture which has been named the "Nitrolite." The fixture consists of a porcelain reflector or shade suspended upon a chain pendant or rod pendant, by means of an especially designed shade holder, and having suspended underneath, by means of three small chains attached to shade holder, a Monax glass diffusing bowl. The object of the combination is first to soften the glaring light from the

FIXTURE FOR NITROGEN LAMPS

nitrogen lamp by means of the diffusing bowl, and second, to increase downward lighting by redirecting the upward rays of light through the means of the porcelain reflector.

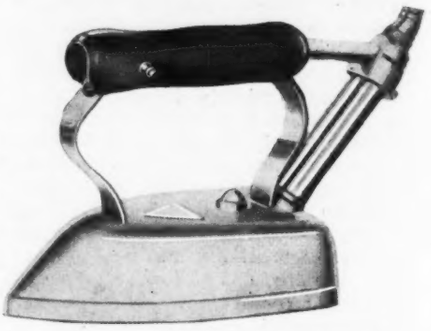
The reflector is sand-blasted on the under side, but is smooth on the upper side. The bowl is smooth on both sides. The latter can be raised or lowered or trued to a perfect alignment by means of three screws which pass through the shade holder and attach to the supporting chains of bowl.

Electric Steering Wheel Warmer

The Interstate Electric Company of New Orleans, La., is placing on the market an electric warming device for use on the steering wheels of motor cars. It consists of a neat leather grip which laces on the rim of the wheel. Special resistance wires are arranged between two copper plates in such a way that a small current suffices to keep the grip comfortably warm. Thermostatic control is provided to maintain the grip at an even temperature. The heating pad is operated from the automobile storage battery or magneto.

Electric Iron

The Savo Electric Company of Toledo, Ohio, has developed an electric iron equipped with a switch which opens automatically when the iron is not in use. The switch button is lo-

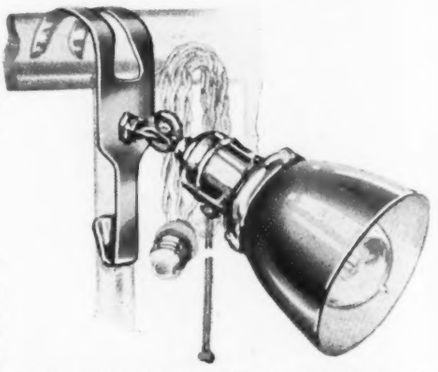


CURRENT IS FROM SWITCH HANDLE

cated in the forward part of the handle, convenient to the thumb. When ironing light pieces, it is pointed out, the current may be released for several minutes by simply removing the thumb. When more current is required simply replace the thumb over the button. It is pointed out that the danger of scorching valuable linen and the danger from fire are eliminated, as the switch opens when the iron is not in use. It is pointed out, also, that the button works exceedingly easily, making no strain on the thumb muscle. The stand is equipped with a catch which will close the button so that the iron may be warmed before using.

Portable Regulating Fixture

A portable lamp with a "Dim-A-Lite" regulating socket is being manufactured by the Wirt Company, Germantown, Philadelphia. In addition to a holder which makes attachment to a bed or back of a chair easy, the fixture is provided with an adjustable hinge bracket, giving flexibility of light direc-



FIVE CHANGES OF LIGHT ARE POSSIBLE

tion. Five changes of light are made possible by the socket regulation device.

The lamp is manufactured in brushed brass and is supplied with 8 ft. (2.4 m.) of flexible cord, with attachment plug.

Trade Notes

PAUL McJUNKIN, formerly of Fahn-McJunkin, Inc., of New York City, is again in business under his own name.

THE LOCKE INSULATOR MANUFACTURING COMPANY has changed its address from Victor to Rochester, N. Y.

THE ELECTRIC STORAGE BATTERY COMPANY of Philadelphia has opened new offices and service station at 1158 Cass Avenue, Detroit.

C. G. YOUNG is now connected with Ford, Bacon & Davis at 115 Broadway, New York City, having given up his offices at 14 Wall Street on Dec. 1.

S. T. HONEY, formerly with the Central Electric Supply Company of New York City, is now manager of the Lindstrom-Smith Company, 396 Broadway.

M. S. ORRICK, formerly sales manager of the Western Electric Company in San Francisco, Cal., has been made assistant manager of the company's branch there.

J. C. MANCHESTER, with the Economy Fuse & Manufacturing Company, Chicago, as district manager in the San Francisco territory, is now established in the Rialto Building.

OLAF E. OLESON, formerly chief engineer of the Commonwealth Edison Company, is now president and general manager of the Edwards Valve & Manufacturing Company, Chicago, Ill.

GEORGE A. SCHNEIDER, formerly in charge of the power equipment department of the Western Electric Company at San Francisco, Cal., has been appointed manager of the Buffalo (N. Y.) office of that company.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis, Mo., announces the opening of a sales office at 129 Church Street, New Haven, Conn. This office is in charge of C. M. French, formerly representative at Springfield, Mass.

PASS & SEYMOUR, INC., Solvay, N. Y., manufacturers of electrical specialties, are planning for the immediate installation of new machinery in the factory building just completed. It is expected to have the new structure in operation by the first of the year.

THE EDISON STORAGE BATTERY COMPANY, Orange, N. J., has removed its New York City sales office from 206 West Seventy-sixth Street to larger quarters, 209 West Seventy-sixth Street, directly opposite. Many additional facilities have been installed in the new place.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY of Pittsburgh, Pa., has filed plans for the construction of a new two-story addition to its transformer building at Trafford City. The structure will be about 55 ft. by 110 ft. The contract has been awarded.

THE ELECTRIC SUPPLIES DISTRIBUTING COMPANY having taken over the business and stock of the wholesale department of the Southern Electrical Company, announces the opening on Dec. 1, 1917, of its business in the Spreckels Building, 924 Second Street, San Diego, Cal. Sam L. Hall is manager.

R. N. EHRHART, formerly chief engineer of the condenser department of the Westinghouse Electric & Manufacturing Company, will engage in consulting engineering work for power-plant equipment, with special reference to turbine and condenser installation. His address is 217 Vine Street, Edgewood, Pittsburgh, Pa.

THE ARTHUR JONES COMPANY of Chicago has removed its general offices and salesroom to 2837-2843 South State Street. The service station is at 8 East Twenty-ninth Street. The change, which became effective Dec. 1, was made necessary by the large increase in business and the need of adequate space and improved facilities.

THE GENERAL VEHICLE COMPANY of Long Island City, N. Y., has closed the negotiations for its sale, on the part of the Peerless Truck & Motor Company of New York City, which owns the entire capitalization. The plant covers eight acres and has 265,000 sq. ft. of floor space, and the consideration is reported at approximately $2,500,000. A statement to the ELECTRICAL WORLD from the Peerless company is to the effect that this sale in no wise disturbs the manufacture of electric trucks, which will be continued as heretofore.

H. T. DYETT, president of the Rome Wire Company of Rome, N. Y., has accepted appointment as a member of the Underwriters' Laboratories Industry Conference for rubber-covered wires and cords. Mr. Dyett was nominated as one of the three manufacturers' representatives on the conference at a recent meeting of the Wire and Cable Section of the Associated Manufacturers of Electrical Supplies. He succeeds the late John C. Bridgman of the Hazard Manufacturing Company. The other manufacturers' representatives are Leroy Clark, president of the Safety Insulated Wire Company, and Everitt Morss, president of the Simplex Wire & Cable Company.

New Incorporations

THE M. & S. ELECTRIC COMPANY of Flint, Mich., has been incorporated with a capital stock of $50,000 by Paul Schagane, L. Carey and DeHull N. Travis.

THE DOMESTIC LIGHTING COMPANY of Tulsa, Okla., has been chartered with a capital stock of $5,000 by R. E. Evans, A. B. Evans and G. B. Bristol of Tulsa.

THE TEXAS BATTERY CORPORATION of Dallas, Tex., has been incorporated with a capital stock of $5,000 by Thomas R. Tennant, Albert Kramer and Max Rothman.

THE DESHLER (NEB.) LIGHT & POWER COMPANY has been chartered with a capital stock of $20,000 by W. F. Kellman, John Bokenkamp, Frank Bokenkamp and H. C. Struve.

THE KER-CARB, LTD., of Toronto, Ont., has been chartered with a capital stock of $20,000 by James H. Spence, 46 King Street West, and others. The company is capitalized at $20,000.

THE JANDOUS ELECTRIC EQUIPMENT COMPANY of Bayonne, N. J., has been chartered with a capital stock of $10,000 by B. Freed, L. Freed and G. Silverman, all of New York, N. Y.

THE EDISON ELECTRIC APPLIANCE COMPANY of New York, N. Y., has been incorporated with a capital stock of $2,650,000 by C. E. Patterson, H. C. Houch and A. H. Jackson of Schenectady, N. Y.

M. J. WOHL & COMPANY of Brooklyn, N. Y., has been incorporated by Maurice J. Wohl, Max Mayer and Bernard Mayer. The company is capitalized at $30,000 and proposes to manufacture electrical specialties.

THE AMERICAN AUTO LAMP COMPANY of New York, N. Y., has been chartered with a capital stock of $10,000 by B. Putterman, M. D. Dreilinger and W. Berke, 1030 Bryant Avenue, New York, N. Y.

THE EDISON ELECTRIC COMPANY of Canton, Ohio, has been chartered by Guy L. Tudor, H. L. Slagle, V. P. Meese and G. M. Montgomery. The company is capitalized at $10,000 and proposes to deal in electrical supplies.

THE SMITH NOVELTY ELECTRIC COMPANY of Charlotte, N. C., has been incorporated with a capital stock of $10,000 by S. J. Smith, E. H. Isenhour and A. B. Justice. The company proposes to manufacture mechanical toys, etc.

THE NELSON ELECTROLYTIC CELL COMPANY of Carteret, N. J., has been incorporated by Hamilton M. Dawes, Selina Aplert and Otto J. Wagner of New York, N. Y. The company is capitalized at $250,000 and proposes to manufacture electric cells and batteries.

THE LESLIE STEVENS COMPANY of New York, N. Y., has been incorporated by H. A. Leslie, C. H. Stevens and W. P. Faendler, 618 Eleventh Street, Brooklyn, N. Y. The company is capitalized at $10,000 and proposes to deal in electrical and general engineering supplies.

THE MILES SMITH CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,000,000 to furnish electricity for lamps, heaters and motors. The incorporators are: C. L. Rimlinger, M. M. Clancy and Clement M. Egner, of Wilmington, Del.

THE ST. ALBANS (W. VA.) ELECTRIC MANUFACTURING & SUPPLY COMPANY has been incorporated by J. M. Britton of Charleston, H. W. Gonla, C. A. Zerkle, L. J. White and J. G. Sheway, all of St Albans. The company is capitalized at $50,000 and proposes to manufacture electrical supplies.

THE COCHRAN BROTHERS CORPORATION of Maysville, Ky., has been chartered with a capital stock of $100,000 for the purpose of furnishing electricity for lamps and motors in Maysville. The incorporators are: H. J. Cochran, R. A. Cochran, W. D. Cochran, J. H. Cochran and A. M. Cochran.

THE HERCULES ELECTRIC STEEL COMPANY of New York, N. Y., has been incorporated with a capital stock of $50,000 by A. Heller, 90 West Street; W. L. Scott, 18 Broad Street, and W. H. Rich, 110 Liberty Street, New York City. The company proposes to manufacture iron, steel, etc., and to act as metal brokers, deal in securities, promotion and to do a general commercial business.

THE DORRITE INSULATION COMPANY, INC., 188-192 Culver Avenue, Jersey City, N. J., has been incorporated with a capital stock of $200,000. Harry A. Dorr is president and general manager; C. O. Hall, vice-president; Robert D. Radcliffe, Jr., treasurer, and R. D. Adams, secretary. A large two-story brick building is now being equipped. The factory will be in operation about Feb. 1, 1918. The company intends to manufacture "Dorrite," an insulating material which may be molded, stamped or pressed into all special or commercial sizes and shapes, for signal, third-rail and all insulating electrical uses.

Trade Publications

DIM-A-LITE.—The Wirt Company of Philadelphia, Pa., has prepared a bulletin descriptive of its "Dim-A-Lite."

TOOL GRINDING.—The Norton Company of Worcester, Mass., has issued a booklet known as "Tool-Room Grinding."

TELEPHONE ATTACHMENT. — The Chicago Writing Machine Company of Galesburg, Ill., has prepared a folder descriptive of its "adjustaphone."

CHAIN DRIVES.—"The Ideal Drive for Clay-Working Machinery" is the title of bulletin No. 310, which has been prepared by the Link-Belt Company of Chicago.

PRESSURE RECORDER. — "Hydro" pressure recorders are illustrated and described in a bulletin prepared by the Bacharach Industrial Instrument Company of Pittsburgh, Pa.

TURBO-GEAR.—The Poole Engineering & Machine Company of Baltimore, Md., has prepared bulletin No. 100, descriptive of its turbo-gear. Typical applications are illustrated and described.

REFRIGERATION.—"Raw-Water Ice" is the title of a bulletin that has been prepared by the De La Vergne Machine Company of New York City. This company has also prepared an attractive bulletin entitled "The Home of De La Vergne." Illustrations of various parts of the factory are given with the intention of presenting to those interested a comprehensive view of the scope of the factory.

ELECTRICAL SUPPLIES.—The Central Telephone & Electric Company of St. Louis, Mo., is now distributing copies of its 1918 catalog. Its preparation is unique, as it describes and illustrates only the appliances and products for which this company is distributer and which are carried in stock. It is a strong cloth-bound book of the loose-leaf type and has been made the exact size of the jobbers' association catalog. Copies may be had on application.

EXPLOSIVES AND BLASTING SUPPLIES.—The E. L. du Pont de Nemours Company, Wilmington, Del., has prepared a book descriptive of several of its products. The table of contents includes the following: High explosives, black blasting powder, blasting supplies, sporting powders, rifle and pistol powders, explosives for military uses, Du Pont Fabrikoid, Fairfield rubber cloth, Py-ra-lin, chemicals, paints and varnishes, miscellaneous commodities, special products, by-products and customers.

INDUSTRIAL MOTORS.—The second of a series of catalogs of industrial motors has just been distributed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. This is known as catalog 30 and covers the company's complete line of direct-current motors and generators for industrial service. After several pages giving general information regarding the ordering, classification and selection of direct-current motors there follows matter covering a complete description, rating and dimensions for type SK commutating-pole motors, various modifications of type SK elevator motors, reversing planer motor equipment, Type CD motors, headstock equipment for woodworking plants, type SK and CD motor generators and arc-welding equipment. Much new information is given, especially on such subjects as arc welding, headstock equipment, motion-picture service and battery-charging service. The new catalog is identical in size and will fit the binder for the company's line of catalogs covering supply apparatus and small motors.

New England States

CAVENDISH, VT.—The Colonial Power & Light Company is increasing the voltage of the transmission line from Cavendish to Claremont from 11,000 to 44,000 volts.

VERNON, VT.—The local transformer station of the Connecticut River Power Company of Brattleboro was recently destroyed.

HUDSON, MASS.—Plans are being considered by the City Council for increasing the output of the municipal electric-light plant to meet the increasing demands for electrical service.

PLYMOUTH, MASS.—The Plymouth & Sandwich Street Railway Company, it is reported, is planning to build an extension from Sagamore Village along the northern shore of Cape Cod Canal to Buzzards Bay Village, a distance of about 5 miles, during the coming spring or summer.

WRENTHAM, MASS.—The Union Light & Power Company is planning to make improvements to both the street and domestic lighting systems in Wrentham.

HARTFORD, CONN.—Plans have been filed by the Colt's Patent Fire Arms Company, Huyshope Avenue, for the construction of a two-story power house, 50 ft. by 95 ft., to cost about $15,000. Contract for building has been awarded.

Middle Atlantic States

ANDOVER, N. Y.—A petition has been filed with the Public Service Commission by the village of Andover asking a certificate of authority to construct and operate an electric-light plant for other than municipal purposes.

COHOES, N. Y.—The Business Men's Association and the Board of Trade has petitioned the City Council for an extension of the ornamental lighting system on White Street, west of Remsen Street, and the extension on Dudley Avenue to Bowery Street.

DUNKIRK, N. Y.—Improvements are being made to the municipal electric-light plant, including the installation of a frequency changer, to provide facilities for using Niagara power in connection with the power generated at the municipal electric plant.

PORT IVORY, S. I., N. Y.—The Procter & Gamble Manufacturing Company, Richmond Terrace and Morningstern Avenue, is building a new generating station, about 40 ft. by 150 ft., and a shop building, to cost about $40,000. Port Ivory has not a post office.

HADDONFIELD, N. J.—The erection of a municipal electric-light plant on a site on Evans Pond is under consideration by the City Council. The construction of a concrete dam, spillway and bulkhead, which makes this body of water available, has been completed.

LODI, N. J.—The Town Council is considering the erection of a new pumping station at the waterworks, plans for which are being prepared by Thomas F. Rowe of East Rutherford.

MADISON, N. J.—For the purpose of conserving fuel the Council has applied to the Board of Public Utility Commissioners for permission to combine the municipal lighting plant with the municipal lighting plant at Chatham, the latter to carry the entire load of the two municipalities from midnight until noon, and the former to carry the heavier load from noon up to midnight. The Council estimates that a saving approximately of 40 per cent of fuel would result from this combination.

MATAWAN, N. J.—The Borough Council is considering the installation of new street lamps in Monroe, Jackson and Center Streets, and equipping the pumping plant of the water-works system throughout for electrical operation.

PERTH AMBOY, N. J.—The City Council is considering extensions and improvements to the electric street-lighting system.

CHAMBERSBURG, PA.—Application has been made to the City Council by J. H. Mowery, manager of utilities, for an appropriation of $60,000 to purchase a 1000-kw. generator and accessories for the municipal electric-light plant.

COATESVILLE, PA.—The Chester Valley Electric Company has issued bonds to the amount of $45,000 for extensions, improvements, etc.

ERIE, PA.—Contract has been awarded by the Erie Forge Company for the construction of a new power plant and substation, 90 ft. by 140 ft., to the James R. Gloyd Company, Hippodrome Annex Building, Cleveland, Ohio.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

HARRISBURG, PA.—The City Council is planning extensions and improvements to the electric street-lighting system in the Riverside district.

HARRISBURG, PA.—Bids will be received by the board of school directors until Dec. 21 for electrical work in the new school building to be erected on Sixteenth Street.

HARRISBURG, PA.—Application will be made to Governor Brumbaugh on Dec. 17 by Morgan D. Kalbach, William Kalbach and Allison Z. Kalbach for three charters, covering Bernville and the townships of Penn and Jefferson, to supply electricity for lamps, heaters and motors.

HARWOOD, PA.—Work has begun on the erection of a new electric transmission line from Harwood to Bethlehem. The new line will be used to serve as an emergency for the connecting link that now extends from Harwood to Hauto and on through the Lehigh Valley to Bethlehem.

HAZLETON, PA.—The Harwood Electric Company has begun work on the erection of an electric transmission line from Freeland to the Pond Creek colliery for the purpose of supplying electricity to operate the works at the latter place. The company is also extending its transmission lines to the plant of the Bethlehem Steel Company.

LANCASTER, PA.—The property of the Lancaster Electric Light, Heat & Power Company has been purchased by the Lancaster County Railway & Light Company. The plant of the former, located at Wabank, which was practically destroyed by fire on Nov. 25, causing a loss of about $15,000, will be rebuilt at once by the Lancaster County company.

LANSDOWNE, PA.—The Delaware County Electric Company, 1000 Chestnut Street, Philadelphia, has issued $2,693,800 in capital stock, the proceeds to be used for extensions, improvements, etc.

NORRISTOWN, PA.—Plans have been prepared for the erection of a new battery house, two-story signal tower and new signal bridge at the Norristown works of the Philadelphia & Reading Railway Company, Reading Terminal, Philadelphia, Pa. Samuel T. Wagner is engineer for the company.

PHILADELPHIA, PA.—The Philadelphia Electric Company has taken over the power house of the Edison Electric Light Company at 904 Sansome Street. The consideration is said to be about $180,000.

PHILADELPHIA, PA.—The Midvale Steel Company has awarded a contract to Barclay, White & Company for the construction of a one-story power house and storage building, 75 ft. by 50 ft., at its plant at Nicetown.

PHILADELPHIA, PA.—Property has been acquired by the American International Shipbuilding Corporation from the Chester branch of the Philadelphia & Reading Railroad Company, beginning at Alburger Lane, on which it will erect a high-tension transmission line to the new Hog Island shipyard to supply electricity for power purposes.

PHILADELPHIA, PA.—The H. Belfield Company, 435 North Broad Street, Philadelphia, Pa., has awarded a contract to the William Steele & Sons Company, 30 South Fifteenth Street, for construction of additions to its plant, including a one-story foundry, 100 ft. by 280 ft.; five-story manufacturing plant, 100 ft. by 280 ft.; one-story power plant, and a one-story warehouse, 100 ft. by 280 ft., to cost about $100,000.

PITTSBURGH, PA.—Notice has been filed by the Consolidated Traction Company with the Public Service Commission of a bond issue of $200,000, to provide funds for extensions and improvements to its system.

ROARING SPRINGS, PA.—The Roaring Springs Light, Heat & Power Company has increased its capital stock by $50,000, the proceeds to be used for extensions, improvements, etc.

SCOTT HAVEN, PA.—Plans have been prepared by W. H. Hill of Pottsville for the erection of a new power house, 40 ft. by 50 ft., one story high, at the plant of the Scott Haven Light Company.

SCRANTON, PA.—The Maccar Truck Company has awarded a contract for the construction of a new power house, 29 ft. by 33 ft., to L. T. Stipp of Scranton.

SCRANTON, PA.—The Jefferson Electric Company has filed notice of a bond issue of $29,000, the proceeds of which are to be used for the purpose of acquiring the plant and property of the Reynolds (Pa.) Light & Power Company.

TACONY, PA.—Permit has been granted to the Tacony Ordnance Company for the erection of a one-story power house, 40 ft. by 50 ft., and for a storage house, one story, 30 ft. by 50 ft., to cost about $12,000. Contract for construction of both buildings has been awarded to Barclay, White & Company.

BALTIMORE, MD.—Most of the machinery to be installed in the new shipbuilding works of the J. Henry Smith Company of Baltimore will be equipped for electrical operation.

BALTIMORE, MD.—The United Railway & Electric Company is planning for the immediate extension of its electric railway system from Curtis Bay line, Stonehouse Cove, to Fairfield, East Brooklyn, and Masonville, near Baltimore.

TRAPPE, MD.—Arrangements have been made for the installation of an electric-light plant in Trappe. Frank Baker and Harry A. Nevius of Trappe are interested.

FAIRMONT, W. VA.—Plans are being considered by the Greater Fairmont Investment Company for the construction of a 10,000-kw. electric generating station.

HARTLAND, W. VA.—The French Coal Company of Hartland is in the market for electric hauling locomotives.

HOPEWELL, VA.—The City Council is considering an issue of $75,000 in bonds for the installation of electric-lighting, water and sewer systems and to equip a fire department.

LYNCHBURG, VA.—The Retail Merchants' Association is considering the installation of an electric-lighting plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for 500,000 ft. of twisted telephone wire to be delivered at the Brooklyn Navy Yard, as per schedule No. 1619.

WASHINGTON, D. C.—Authority has been given the Potomac Electric Power Company by the Public Utilities Commission to change the date of issue of $127,000 of its general improvement debenture bonds from Jan. 2, 1915, to Jan. 2, 1918. The proceeds are to be used for improvements.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Dec. 17 for furnishing two 300-kw. motor-generator sets and switchboards at the navy yard, New York; four 300-kw. motor-generator sets and switchboards at the navy yard, Philadelphia, Pa.; four 300-kw. motor-generator sets and switchboards at the navy yard, Norfolk, Va., and three 500-kw. motor-generator sets at the navy yard, Washington, D. C. Drawings and specifications (No. 2711) may be obtained on application to the above bureau or to the commandants at the navy yards named.

North Central States

GRAND RAPIDS, MICH.—Bonds to the amount of $1,500,000 have been authorized by the United Light & Railways Company, Michigan Trust Company Building, Grand Rapids, which owns and operates 21 utility properties and serves 53 communities with gas, electric, street or interurban railway service in the states of Iowa, Illinois, Indiana, Michigan and Tennessee. Of the proceeds $750,000 will be used to retire outstanding notes and the remainder for additions, extensions and improvements to its properties.

LUDINGTON, MICH.—Application has been made to the City Commission by Frank Hawley, who was for 16 years manager of the Steam, Lighting & Power Company, for a franchise to operate an electric light and power plant in Ludington. The commission has granted the franchise subject to the approval of the voters. Mr. Hawley resigned from the steam company when an interest was sold to the Commonwealth Light & Power Company of New York.

MONROE, MICH.—Electricity for operating the local system is being supplied by the Detroit Edison Company, which secured a franchise in Monroe a few months ago. The old municipal electric plant will be dismantled and the property turned over to the city.

CLEVELAND, OHIO.—Contract has been awarded by the Ideal Tire & Manufacturing Company, 385 Guardian Building, for the erection of a factory building. Equipment, including boilers, generator and machinery for the manufacture of rubber goods, is to be purchased.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Dec. 21 for switchboard, oil switches and reactors for the division of light and heat. Specifications may be obtained upon application to the division of light and heat.

LIMA, OHIO.—Business men and property owners on Main Street and the public square have petitioned the City Council for the installation of an ornamental lighting system for that district similar to that on West Market Street.

OXFORD, OHIO.—Bids will be received by F. L. Packard, architect, of Columbus, until Dec. 22 for an addition to the chemistry Building for Miami University at Oxford. Plans are on file at the office of the architect, Columbus, and at the office of Walter L. Tobey, chairman of special building committee at Oxford.

ST. CLAIRSVILLE, OHIO.—The property of the Sunnyside Electric Company, which furnishes electricity in five counties including Belmont, Stark, Jefferson, Harrison and Carroll, has been taken over by the Central Power Company of Canton.

YOUNGSTOWN, OHIO.—The Public Utilities Commission has granted the Mahoning & Shenango Railway & Light Company permission to issue $500,000 in bonds, to be sold at not less than 90.

FRANKFORT, KY.—Bids will be opened about Jan. 1 for the construction of the Frankfort & Shelbyville Electric Traction Company's railway from Frankfort to Shelbyville, about 19 miles long. The P. C. Phillip Engineering Corporation, Real Estate Trust Building, Philadelphia, Pa., has charge of the surveys. P. C. Phillip is vice-president and general manager.

MAYKING, KY.—Plans are being considered by W. C. Daniels & Son of Whitesburg for the erection of an electric transmission line to Mayking, a distance of 5 miles.

MAYSVILLE, KY.—The Cochran Brothers Corporation, recently incorporated with a capital stock of $100,000, is planning to build an electric plant in Maysville. R. A. Cochran, H. J. Cochran, J. H. Cochran and A. M. J. Cochran are the incorporators.

PINEVILLE, KY.—The Williams By-Product Coal Company, recently incorporated, is planning to install new electrically operated machinery at its plant. J. W. Williams of Corton is president.

MOORESVILLE, IND.—C. E. Layton of Sheridan has purchased the electric water, ice and heating plants of the Mooresville Public Service Company.

NAPANEE, IND.—The municipal electric-light plant has been purchased by the Napanee Utilities Company for $50,000.

OAKLAND CITY, IND.—The Ayrshire Coal Company is considering the purchase of an electric generating unit of from 150 to 200 kw., 250 volts.

SHERIDAN, IND.—The Sheridan Water, Light & Heat Company has recently purchased a 150-kva. Ames-Stumpf uniflow engine unit. C. E. Layton is secretary and treasurer.

CARTHAGE, ILL.—The Central Illinois Public Service Company of Mattoon has asked the City Council for permission to construct high-tension transmission lines through Carthage in order to connect the Augusta, Beardstown and Macomb circuit with a complete circuit, and which would permit getting into the Beardstown district by two routes. E. V. Graham, 116 South Sixteenth Street, Mattoon, is secretary of the company.

CHICAGO, ILL.—A permit has been granted to McCord & Company, 847 West 120th Street, West Pullman, a suburb of Chicago, for the erection of a one-story foundry, 72 ft. by 214 ft., to cost about $30,000; a transformer room, to cost $2,300, and a blower house, to cost $1,700.

URBANA, ILL.—The capital stock of the Urbana Light, Heat & Power Company has been increased from $150,000 to $200,000.

JANESVILLE, WIS.—The Janesville Electric Company is considering the installation of a 150-hp. water turbine unit at its hydroelectric plant on Rock River.

LA CROSSE, WIS.—Within 30 days, it is stated, power will be received from the Wissoda dam to operate the local plant of the Wisconsin-Minnesota Light & Power Company.

STEVENS POINT, WIS.—Work will be finished on the new transmission line between Mosinee and Stevens Point about Jan. 1. The new line is 22 miles long and will connect up the water powers of Whiting-Plover and Mead-Witter in the Stevens Point district, and the power of Mosinee, Merrill, Rothschild and Wausau.

PILLAGER, MINN.—The new dam of the Cuyuna Range Power Company at Pillager is practically completed. The structure is 750 ft. long and has a 15-ft. head and cost about $600,000. The plant will supply electricity for lamps and motors to the iron mines on the Cuyuna Range.

DAVENPORT, IOWA.—Plans are being considered by the Brady Street Merchants' Association for securing an improved lighting system on that thoroughfare.

DES MOINES, IOWA.—The Inter-Urban Railway Company is building 10 miles of second track between Des Moines and Camp Dodge and 13 miles of yards and sidings.

IOWA CITY, IOWA.—The erection of a hydraulic experiment station on the other side of the river near the west end of the large dam, to cost about $15,000, is reported to be under consideration.

McCAUSLAND, IOWA.—A special election has been called to be held on Dec. 17 to vote on the proposal to grant a franchise to William Stutzel, R. D. Anderson and F. E. Ringley to construct and operate an electric-lighting system in McCausland.

CAMERON, MO.—The City Council is contemplating improvements to the municipal electric light plant.

FOREST CITY, MO.—Steps have been taken by local business men for the installation of an ornamental lighting system in the business district. Electricity for operating the system will be obtained from St. Joseph.

LEITH, N. D.—Machinery has been received for the new electric-light plant at Leith, which will be operated by a company organized by local citizens.

NEW ENGLAND, N. D.—The Sterling Electric Company has recently completed the installation of a 37½-kw. and a 7½-kw., 2300-volt, alternating-current generator, driven by Muncie oil engines, in New England.

FALLS CITY, NEB.—The City Council is considering calling an election to submit the proposal to issue $75,000 in bonds for remodeling the municipal electric-light plant.

LINWOOD, NEB.—The property of the Stava & Franklin Electric Company has been acquired by William Lowman.

OCONTO, NEB.—At an election recently held the proposal to issue $3,900 in bonds for a municipal lighting plant was defeated.

ORD, NEB.—The Ord Telephone Co. is contemplating erecting a telephone line from Ord to Sargent, a distance of 30 miles.

ABILENE, KAN.—The Riverside Light, Power & Gas Company, it is reported, is contemplating the purchase of a new turbine.

AGENDA, KAN.—Electricity for operating the proposed municipal electric-light plant will be secured from the plant of the Concordia (Kan.) Electric Light Company.

KANOPOLIS, KAN.—Funds have been raised by the business men for the installation of an ornamental lighting system on Main Street.

KANSAS CITY, KAN.—Plans are being considered by the City Council for issuing $200,000 in bonds for extensions and improvements to the municipal electric-light plant.

LIBERAL, KAN.—The property of the Liberal Light, Ice & Power Company, consisting of an electric plant and ice factory, has been purchased by the Commonwealth Light & Power Company.

POTWIN, KAN.—At an election to be held Dec. 18 the proposal to issue $3,000 for the installation of an electric-lighting system in Kansas will be submitted to the voters. Electrical service will be obtained from the Kansas City Gas & Electric Company of Wichita.

Southern States

MONROE, N. C.—The installation of a new street-lighting system in Monroe is under consideration.

ROUGEMONT, N. C.—W. A. Carver is contemplating extensions to his plant to transmit electricity from 1 to 2 miles. Mr. Carver would like to receive prices on a new and a second-hand electric generator of from 5 to 100 kw.; motors 10 to 30 hp.; wire, fittings, etc. (excepting poles, for transmission line), 1 to 2 miles, and lamps for residences; also prices on iron or steel pipe 24 in. to 30 in. in diameter.

SPARTANBURG, S. C.—Contract has been awarded by the Piedmont & Northern Railway Company of Charlotte, N. C., for the construction of a spur from Spartanburg to Camp Wadsworth, a distance of 2 miles, to the Porter & Boyd Construction Company. E. Thomason of Charlotte, N. C., is vice-president and general manager.

CORDELLE, GA.—The property of the Cordelle Electric Company has been purchased by the Georgia Public Service Company of Tifton.

DECATUR, GA.—The City Council has awarded a contract to the Georgia Railway & Power Company for equipping the pumping station of the water works for electrical operation. The plans provide for the installation of new electrically operated triplex pumps and auxiliary equipment.

TIFTON, GA.—The Georgia Public Service Company has purchased the property of the Tifton Ice & Power Company. The company has also bought the plant and holdings of the Cordelle (Ga.) Electric Company.

LEESBURG, FLA.—O. S. Lang, it is reported, would like to receive information on an electric-light plant for a $7,000 clubhouse.

COAL CREEK, TENN.—Preparations are being made by the Black Diamond Coal Company of Knoxville for the installation of a new electric generating plant (alternating current) at its local plant.

FOUNTAIN CITY, TENN.—Plans are being considered for the installation of an electric-lighting system in Fountain City.

KNOXVILLE, TENN.—The John G. Duncan Company of Knoxville, it is reported, would like to receive prices on a double-cylinder, double-drum hoisting engine and boiler. 8½-in. by 10-in. cylinders, about 30 hp.; also for a similar engine, 5½ in. by 7 in., or 6½ in. by 8 in.

BIRMINGHAM, ALA.—Prices are being asked on a 350 to 400-kva., 3-phase, 60-cycle, 2300-volt generator directly connected to a cross compound generator, complete with exciter and switchboard. Howard H. Glassman, Brown-Marx Building, Birmingham, is consulting engineer.

BIRMINGHAM, ALA.—Plans are being prepared by the Alabama Interurban Corporation for the construction of an electric railway from Gadsden and Mobile on one end and to Albany and Sheffield on the other. The present plans, it is understood, provide for the Albany-Sheffield branch to extend through Jasper and connect with the Mobile-Gadsden branch at Greensboro.

DOTHAN, ALA.—The Houston Power Company, recently incorporated with a capital stock of $25,000, it is reported, contemplates the construction of a hydroelectric plant in Dothan. H. F. Deal of Dothan is interested.

GADSDEN, ALA.—Plans are being considered for the installation of electric motors, shafting, etc., in the Davis-Alcott Hosiery Mills at once.

EARLE, ARK.—The Arkmo Lumber Company is contemplating improvements to its plant, including equipping the machinery for electrical operation. The cost is estimated at $6,000.

JUNCTION CITY, ARK.—The City Council has appointed a committee to take up with the Arkansas Light & Power Company the matter of extending its electric transmission lines from El Dorado to Junction City to supply electricity for lamps and motors in the latter city.

NEW ORLEANS, LA.—The Machinery Exchange Company of New Orleans is reported to be in the market for 2000 hp. in boilers, a 1500-hp. condensing engine and other machinery.

ALINE, OKLA.—The installation of a municipal electric-light plant is under consideration. Bids are being received by the city of Caldwell for material for the construction of a power house, which probably will be erected by day work. Burns & McDonnel, Interstate Building, Kansas City, Mo., are engineers.

LAVERNE, OKLA.—At an election held recently bonds to the amount of $13,000 were authorized for the purchase of the property of the Laverne Light, Power & Ice Company.

OKMULGEE, OKLA.—The Omaha Lead & Zinc Company of Okmulgee, recently incorporated with a capital stock of $350,000, is reported to be in the market for mining and power plant equipment. E. J. Dick of Okmulgee is one of the incorporators.

WOODWARD, OKLA.—An election will soon be held to vote on the proposal to issue $20,000 in bonds for an electric-light plant and $7,000 for water works.

ABILENE, TEX.—The West Texas Utilities Company of Abilene, recently organized with a capital stock of $400,000, has taken over the properties of the Abilene Gas & Electric Company, the Baird (Tex.)

Gas & Electric Company and the Hamlin (Tex.) Gas & Electric Company. It is understood that the plants will be enlarged and new machinery installed. The incorporators are: George W. Williamson of Chicago, Ill.; J. M. Dickie, J. F. Meadows and F. A. Matthes, all of Abilene; A. Hargrave and Sidney Vigo of Dallas.

FORT WORTH, TEX.—Preparations are being made to double the output of the power plant of the Fort Worth Power & Light Company, located at the foot of the Paddock Viaduct. Orders have been placed for a 23,000-kw. steam turbo-generator set. Work has already begun on the erection of the addition to the power house. The company has increased its capital stock from $3,860,000 to $4,360,000. A. J. Duncan is president.

MARSHALL, TEX.—The East Texas Utilities Company of Marshall, recently organized with a capital stock of $300,000, has taken over the plant holdings of the Marshall Electric Company, the Marshall Traction Company and the Marshall Ice Company; the Jefferson (Tex.) Ice & Light Company and the Longview (Tex.) Ice & Light Company. The plants, it is understood, will be enlarged and new machinery will be installed. Among the incorporators are: George W. Williamson of Chicago, Ill.; J. M. Dickie of Abilene and Sidney G. Vigo of Dallas, Tex.

PORT ARTHUR, TEX.—The Port Arthur Laundry Company, Fourth and Fort Worth Streets, would like to receive prices on electrical equipment.

Pacific and Mountain States

BELLINGHAM, WASH.—The Olympic-Portland Cement Company is considering changing its oil-burning plant to a coal burner, which will include the installation of coal-pulverizing machinery.

FORT FLAGLER, WASH.—The Arrow Electric Company of Seattle has been awarded the contract for installing all electric wiring, transformers, street-lighting systems, etc., for the United States Army contonments at Forts Flagler, Casey and Worden. About 40 buildings will be erected.

KELSO, WASH.—The North Coast Power Company is contemplating an extension of its transmission line from Kelso to the new pumping plant to be erected near Freeport, to reclaim several hundred acres of land lying within the bend of Horseshoe Lake.

PROSSER, WASH.—The City Council has decided to accept the proposal of the Pacific Power & Light Company to have the street arc lamps replaced by incandescent lamps.

RENTON, WASH.—Plans have been completed by the Chicago, Milwaukee & Puget Sound Railway Company for the construction of a substation at Walla Walla Avenue and Cedar Street in Renton, to cost about $75,000, in connection with equipping the railroad over the Cascade Mountains for electrical operation.

SHELTON, WASH.—Application has been made to the County Commissioners by the Shelton Light & Power Company for a franchise to erect and operate electric transmission lines from its plant at Goldsborough Creek over the county roads.

TACOMA, WASH.—The Tacoma Railway & Power Company is planning to etend its lines directly into Camp Lewis, a distance of about 5 miles.

TACOMA, WASH.—The City Council has voted to extend the municipal car line from the present terminus at Eleventh Street and Taylor Way to Lincoln Avenue, a distance of 1 mile, to cost about $20,000.

TACOMA, WASH.—The shops of the Chicago, Milwaukee & St. Paul Railway at Tacoma, it is reported, will be enlarged. Equipping the railroad to Puget Sound for electrical operation will soon be completed.

TACOMA, WASH.—A power site on the headwaters of the Cowlitz River, about 58 miles from Tacoma, upon which about $260,000 has been expended for preliminary surveys and construction work, has been offered to the city of Tacoma by J. H. Cunningham, hydraulic engineer of Portland, Ore. F. K. Devens and Fred Murray, representing the Skyhomish Power Company, have also offered a site on the Stillaguamish River site and have outlined a plan whereby the city of Tacoma could secure the site and a plant complete at $4,000,000.

VANCOUVER, WASH.—The City Council has adopted the contract submitted by the Portland Railway, Light & Power Company for lighting the streets of the city.

BEND, ORE.—The Deschutes White Pine Lumber Company is planning to start work on the construction of a sawmill at Pringle Falls, to have a capacity of 80,000 to 100,000 ft. to start with, in the spring. The plans provide for a hydroelectric power development of about 2250 hp., the entire river to be diverted through a 1000-ft. canal with an 8-ft. fall at the end.

PORTLAND, ORE.—The Commission of Public Docks has authorized Chief Engineer Hegardt to ask for bids at once on motors and transformers for the St. Johns terminal project, which includes municipal grain elevator and additional dock space.

ALAMEDA, CAL.—The city of Alameda has entered into a contract with the Great Western Power Company of San Francisco to furnish the city with electricity through marine cables from the Oakland lines for a period of five years.

BAY POINT, CAL.—Surveys are being made by the Great Western Power Company, 14 Sansome Street, San Francisco, for the purpose of supplying energy to the plant of the Pacific Electro Metal Company at Bay Point. The power company has a contract to furnish 4000 kw. to operate the first unit of the chemical plant now in course of construction.

ESCONDIDO, CAL.—Plans are being prepared by the San Diego Consolidated Gas & Electric Company for the erection of a three-phase electric transmission line into San Pasqual Valley in the near future.

LOS ANGELES, CAL.—Through F. M. Merrill and W. B. Baker of Los Angeles the Coachella Power & Irrigation Canal Company has filed application with the State Water Commission to install an irrigation system in the Morengo Valley, San Bernardino County, to cost about $4,900,000. The company proposes to irrigate 25,000 acres and to develop a hydroelectric project of 30,000 hp. from two power plants, to be located above the Whitewater River Valley, to which the waters will be carried for irrigation purposes in 65 miles of canals and pipe lines. Morengo Valley will be used as a storage reservoir with a capacity of 150,000 acre ft.

MERCED, CAL.—Steps have been taken by the City Trustees toward taking over the electric-light, gas and water systems in the city, to be owned and operated by the municipality.

OROVILLE, CAL.—The Great Western Power Company has purchased a site of 1255 acres having a frontage of 2½ miles on the Feather River, which will be used as a site for its proposed $6,000,000 power plant. The water for the new plant will be diverted from the North Fork of the Feather River immediately after it leaves the Las Plumas plant of the company. It will be carried in a large concrete canal to a point about 2 miles north of Oroville, where it will be dropped a distance of 500 ft. down the mountainside into the power plant. Rights of way for the canal have already been obtained. The proposed plant, it is estimated, will develop about 60,000 hp.

PASADENA, CAL.—The City Commissioners have made an arrangement with the city of Los Angeles for the purchase of electricity to be used by the lighting department. It is understood to be purely a war measure subject to recall at any time.

REDDING, CAL.—A permit has been granted to William A. McEwan of Redding to use 25 second-ft. of water of Boulder Creek and Little Boulder Creek in Trinity County.

SAN DIEGO, CAL.—Plans are being considered to equip the La Jolla Beach Railway line for electrical operation.

SAN DIEGO, CAL.—Plans for the construction of an electric railway into the Mountain Empire from Lakeside to Santa Ysabel, a distance of about 22 miles, is under consideration by the San Diego Southeastern Railway Company. E. J. Burns of San Diego is manager.

SANTA ROSA, CAL.—Application has been made to the State Railroad Commission by the California Telephone & Light Company of Santa Rosa for permission to extend its transmission system in order to serve Summer Home Park and vicinity in Sonoma County.

STOCKTON, CAL. — The Tidewater Southern Railway Company is planning to complete its extension to Livingston, 10 miles long. It also contemplates equipping the line southward from Modesto for electrical operation.

UKIAH, CAL.—The Snow Mountain Water & Power Company of Ukiah, which operates a hydroelectric power plant in Mendocino, Lake, Sonoma and Napa Counties, has filed an application for an extension of time within which to comply with the statutes concerning the standardization of pole lines.

COEUR D'ALENE, IDAHO.—The City Council has voted to offer the Consumers' Power Company and the Kootenai Power Company, which furnishes electricity for lamps and motors in Coeur d'Alene, a contract to furnish the service for six years, instead of twelve years as asked by the companies.

HALLEY, IDAHO.—At an election held recently the proposal to issue $100,000 in bonds to establish a municipal electric-light plant was defeated.

PRICE, UTAH.—At an election to be held Dec. 22 the proposal to lease the municipal electric-light plant to J. H. Manson for a period of 25 years will be submitted to the voters. Mr. Manson, who has managed the plant for the past two or three years, has submitted a proposition to the Council to lease the plant, offering to pay off the bonded indebtedness ($25,000), furnish electricity for lighting the streets and public buildings in the city free of cost, and to make all needed extensions and turn the plant back to the city in first-class condition and free from indebtedness at the expiration of the lease.

SALT LAKE CITY, UTAH.—Steps have been taken to create a special lighting district on Regent Street. It is proposed to use 6.6-amp. lamps, somewhat similar to those in use on Main Street. Each standard will carry one lamp.

YUMA, ARIZ.—Plans for voting $200,000 bonds, the proceeds to be used in the construction of municipal electric light and water works plants here, have been blocked by the refusal of Mayor George Michalson to sign the ordinance calling the election.

KALISPELL, MONT.—The property of the Northern Idaho & Montana Power Company has been sold at public auction to Robert J. Graf, representative of the stockholders of the company.

KALISPELL, MONT.—City Council has adopted a resolution, on the recommendation of the light and water committee to provide the city with a special lighting district that will embrace the whole city. The cost of the improvement is placed at $14,500, and the cost of maintaining the lamps and supplying the electrical current therefor for the first year is estimated at $11,900. R. E. Rollins, city clerk.

GREELEY, COL.—The car barns and power house of the Greeley & Denver Railway Company were recently destroyed by fire, causing a loss of about $35,000. Electricity for operating the system was obtained from the Western Light & Power Company of Boulder.

Canada

PORT MOODY, B. C.—The Aetna Steel Works here will install a six-ton electric smelter furnace, which is expected to be in operation in January.

VICTORIA, B. C.—J. C. Corbin, Arcade Building, Seattle, Wash., has been engaged by a Canadian firm to prepare plans for changes in its refrigerating plant in Victoria, to cost about $25,000. The capacity of the plant will be increased and it will be equipped for electrical operation. Special motors and machinery will be installed.

CHATHAM, ONT.—The T. H. Taylor Company of Chatham, it is reported, would like to receive prices on a complete outfit of Jones underfeed stokers for two boiler installations, including engine, fan, etc.

GOWGANDA, ONT.—Plans, it is understood, are under way for the development of a hydroelectric plant at Big Bend Falls to supply electricity in Gowganda and the new mining district of Matachewan. It is estimated that between 5000 hp. and 6000 hp. can be developed at Big Bend Falls.

OMEMEE, ONT.—A by-law will soon be submitted to the ratepayers asking for an appropriation of $9,000 for installation of a hydroelectric plant.

OTTAWA, ONT.—Bids will be received by John A. Pearson, architect, Ottawa, until Dec. 17, for electric conduits, outlets and fittings required in the reconstruction of the Parliament Building at Ottawa. Specifications and other information may be obtained at the office of the P. Lyall & Sons Construction Company, Ottawa.

SAULT STE. MARIE, ONT.—The connecting link between the upper St. Mary's River and the new power canal at the St. Mary's River has now been broken; the water which will increase the supply of power for this city has been let into the new canal, and it is expected that the first unit in the new power house will be put in operation about the middle of January. Thereafter units will be placed in commission until the whole 34 units will have been put in operation, which it is expected will take about five months longer.